PROGRAM LIBRARY

CASIO®

FX-603P

(英)

FX-603P
PROGRAM LIBRARY

CASIO

Library programs may not suit your specific purposes but these programs are designed to be used as a guide in building programs exactly suited to performing the calculations you need. The description of the program and the use of registers and remarks will facilitate modification.

PLEASE NOTE

The programs in this library book are provided to be used freely; no licence or permission for use is required.
CASIO, however, disclaims all responsibility for any losses or missed profits incurred through use of these programs.
The program library is subject to addition and improvement without prior notice.

This program library gives sample programs used in the CASIO FX-603P. Programs are divided according to each category.

For each program, one program example is given on a double-spread of left and right pages (it may continue to the following pages). The left-hand pages are for the program name, formula and example (test data), key operation and respective display. The right-hand pages are for the contents of the programming, contents in memories, notes and remarks. (Except Mathematics-4 and Statistics-11)

To perform programmed calculations, it is first necessary to correctly write (store) the program shown on the right-hand page into the calculator.
To write a program, put the calculator in the WRT mode (press [MODE] [3] [2ndF] [MAC] [MODE] [2] as shown in the preparation line). If the program area for write-in is empty, [MODE] [3] [2ndF] [MAC] (This operation clears all the program area) can be omitted.

Following completion of the above preparations, key in the program instructions for each line, reading from left to right. The punctuation symbols (I) are simply to separate neighboring step and should not be keyed in.

The Step column at the right edge of the Program column shows the number of steps displayed during the WRT mode. This number will be the same as the number of punctuation symbols. The total number of the steps used in the program (including P No. setting) are shown at the end of the Step column.

After writing in each line of program, check the step number both in the Step column and in the display of the calculator. This will allow early detection of errors.

When entering a program, make sure that you discriminate between the following symbols.
Letter "X", and multiplication symbol " × "
Letter "O", and zero "0"
Letter "F", and memory "F" (EXP / F)
Semicolons (M− / ;) and colons (O / :)
Letters "A" and "R", and command "AR"

When program writing is completed, now you can start execution of the program. Put the calculator in the RUN mode (MODE 1) and perform Key Operation as shown on the bottom of the left-hand page. When using the sample data given, the correct sample answer must be displayed. This allows you to confirm that the program is properly written in. Then, go on to perform the actual desired calculations. When the Key Operation column is blank and there is an entry in the Display column, this indicates an automatic change in the display (pause display or alphabetical characters of 12 or more) continuing from the display of the previous operation.

Mathematics

1 Prime factor analysis 1
2 Greatest common measure 3
3 Calculation of remainder 5
4 Complex arithmetics 7
5 Transformation of coordinates 11
6 4-by-4 determinant 13
7 3 variable linear equations 15
8 Solving a cubic equation by the Newton method 17
9 Definite integral by the Simpson's rule 19

Electrical engineering

1 $\Delta \leftrightarrow$ Y conversion 21
2 Impedance of series and parallel circuits 23
3 Impedance of series resonance circuit 25
4 Design of an active low-pass filter 27
5 Design of an active band-pass filter 29
6 Impedance of transmission line 31
7 T-and π-attenuators 33
8 Minimum loss matching 35
9 Distributed constant circuit 37

Mechanics

1 Cantilever under concentrated load 39
2 Simple beam under distributed load 41
3 Beam fixed at both ends under concentrated load 43
4 Free vibration 45
5 Design of coil spring 47

Physics/chemistry

1 Simple pendulum 49
2 Parabolic movement 51
3 Thermal conduction through layers 53
4 First- and second-order reaction speeds 55

Statistics

1 Geometrical and harmonic means 57
2 n-month moving average (n $\leqq$ 77) 59
3 Spearman's coefficient of rank correlation 61
4 Regression analysis (linear, exponential, logarithmic, power) . 63
5 Quadratic regression analysis 65
6 Normal distribution 67
7 x^2 distribution 69
8 F-distribution 71
9 t-distribution 73
10 F-test 75
11 t-test 77
12 m-by-n contingency table 81

Medicine

1 Removal of urea 83
2 Surface area of a human body 85
3 Indication of red corpuscle 87

Banking

1 Calculation for loan-repayment I
(equally divided monthly repayment) 89
2 Calculation for loan-repayment II
(Interest on equally divided monthly repayment) 91
3 Calculation of compound annual interest 93
4 Calculation for discounting commercial bills
(by annual interest basis) 95
5 Calculating for depreciation 97
6 Calculation of aggregate classification and prorating 99
7 Horizontal/vertical aggregate calculations 101

Navigation

1 Astronomical observation 103
2 Great circle navigation 105

Game

1 Secret number game 107
2 Gopher game 109
3 Shuffle-number game 111
4 Hit-and-blow game 113
5 Search-bug game 115

CASIO PROGRAM SHEET

Program for	Prime factor analysis	No.	Mathematics–1	

Description

• Input the program written in the next page.

Prime factors of arbitrary positive integers are selected.

For $1<m<10^{10}$
prime numbers are selected starting with the smallest.
When "END" is displayed, the program ends.

<Approach>
m is divided by 2 and d = 3, 5, 7, 9, 11, 13 . . . . (all odd numbers) in that sequence, and divisibility is determined. Where d is a prime number, $m_i=m_{i-1}/d$ is assumed, and division is repeated until $\sqrt{m_i}+1 \leqq d$.

Example

Example 1

119=7 x 17

Example 2

1234567890 = 2x3x3x5x3607x3803

Step	Data input operation	Read-out	Step	Data input operation	Read-out
	MODE 1	0.	7	EXE	START×2×3×3×5 5.
1	<Ex.1> 119 PO	START×7 7.	8	EXE	ART×2×3×3×5×3607 3607.
2	EXE	START×7×17 17.	9	EXE	×3×3×5×3607×3803 3803.
3	EXE	START×7×17×END 17.	10	EXE	×5×3607×3803×END 3803.
4	<Ex.2> 1234567890 PO	START×2 2.	11		
5	EXE	START×2×3 3.	12		
6	EXE	START×2×3×3 3.	13		

Remarks

The read-out of step 8 will appear after approx. 1 min. 10 sec.

Program for

Prime factor analysis

	Program	Remark	Step
	MODE 3 2ndF MAC MODE 2		
1	PO Min 01 AC "AL CAPS S T A R T AL" GOTO 2		10
2	LBL 1 MR 01 ÷ 2 "AL ; × α-s # AL" HLT =		21
3	Min 01 − 1 = SHIFT x=0 GOTO 0		27
4	LBL 2 MR 01 ÷ 2 = SHIFT FRAC SHIFT x=0 GOTO 1		35
5	LBL 3 3 Min 02		38
6	LBL 4 MR 01 SHIFT √ Min F 1 M+ F		44
7	LBL 5 MR 01 ÷ MR 02 SHIFT x≥F GOTO 7 =		51
8	SHIFT FRAC SHIFT x=0 GOTO 8		54
9	LBL 6 2 M+ 02 GOTO 5		58
10	LBL 8 MR 01 ÷ MR 02 × MR 02 − MR 01 =		67
11	SHIFT x=0 GOTO 9 GOTO 6		70
12	LBL 9 MR 01 ÷ MR 02 "AL ; × α-s # AL" HLT		80
13	= Min 01 GOTO 4		83
14	LBL 7 MR 01 "AL ; × α-s # AL" HLT		91
15	LBL 0 "AL ; × E N D AL"		99
16			
17		Total 100	
18			
19			
20			
21			
22			
23			
24			
25			
26			
27			
28			
29			
30			
31			
32			
33			
34			
35			
36			
37			

	Contents in memories
00	
01	mi
02	d
03	
04	
05	
06	
07	
08	
09	
F	$\sqrt{m+1}$
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
1F	
20	
21	
22	
23	
24	
25	
26	
27	
28	
29	
2F	

Note

When division is completed in lines 7~8, the resulting numerical values are again checked in lines 10~11, and confirmation made that these are indeed prime numbers. This eliminates errors due to computer rounding of numbers.

CASIO PROGRAM SHEET

Program for	Greatest common measure	No.	Mathematics–2	

Description

• Input the program written in the next page.

Euclidean general division is used to determine the greatest common measure of two integers a and b.

For $|a|, |b| < 10^9$, positive values are taken as $<10^{10}$.

<Approach>

$n_0 = \max(|a|, |b|)$

$n_1 = \min(|a|, |b|)$

$$n_k = n_{k-2} - \left[\frac{n_{k-2}}{n_{k-1}}\right] n_{k-1}$$

$k = 2, 3 \ldots\ldots\ldots\ldots$

If $n_k = 0$, then the greatest common measure (c) will be n_{k-1}.

Example

	Example 1	Example 2	Example 3
IF	a = 238	a = 23345	a = 522952
	b = 374	b = 9135	b = 3208137866
THEN	c = 34	c = 1015	c = 998

Step	Data input operation	Read-out	Step	Data input operation	Read-out
	MODE 1	0.	7	<Ex.3> PO	INPUT <a> 0.
1	<Ex.1> PO	INPUT <a> 0.	8	522952 EXE	INPUT <b> 0.
2	238 EXE	INPUT <b> 0.	9	3208137866 EXE	<c>= 998.
3	374 EXE	<c>= 34.	10		
4	<Ex.2> PO	INPUT <a> 0.	11		
5	23345 EXE	INPUT <b> 0.	12		
6	9135 EXE	<c>= 1015.	13		

Remarks

Program for

Greatest common measure

	Program	Remark	Step
	MODE 3 2nd F MAC MODE 2		
1	P0		
2	AC ‖ "AL ‖ CAPS I ‖ N ‖ P ‖ U ‖ T ‖ α-s SPACE ‖ α-s < ‖ CAPS a ‖		10
3	α-s > ‖ AL" ‖ HLT ‖ SHIFT ABS ‖ Min 01 ‖ Min F ‖		16
4	AC ‖ "AL ‖ CAPS I ‖ N ‖ P ‖ U ‖ T ‖ α-s SPACE ‖ α-s < ‖ CAPS b ‖		26
5	α-s > ‖ AL" ‖ HLT ‖ SHIFT ABS ‖ Min 02 ‖		31
6	SHIFT x≥ F ‖ X-M01 ‖ Min 02 ‖		34
7	LBL 1 ‖ MR 01 ‖ ÷ ‖ MR 02 ‖ = ‖ SHIFT INT ‖ × ‖ MR 02 ‖ − ‖ MR 01 ‖ = ‖		45
8	+/− ‖ SHIFT x=0 ‖ GOTO 2 ‖		48
9	X-M02 ‖ Min 01 ‖ GOTO 1 ‖		51
10	LBL 2 ‖ MR 02 ‖ "AL ‖ α-s < ‖ C ‖ α-s > ‖ = ‖ AL" ‖		59
11			
12			
13		Total 60	
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			
25			
26			
27			
28			
29			
30			
31			
32			
33			
34			
35			
36			
37			

	Contents in memories
00	
01	a n0
02	b n1
03	$nk(nk-2-\left[\frac{nk-2}{nk-1}\right]nk-1)$
04	
05	
06	
07	
08	
09	
F	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
1F	
20	
21	
22	
23	
24	
25	
26	
27	
28	
29	
2F	

Note

CASIO PROGRAM SHEET

Program for	Calculation of remainder	No.	Mathematics-3	

Description

• Input the program written in the next page.

This program determines the quotient (integer portion of the answer) and the remainder which result from division.

Example

Example 1

100 ÷ 7 = 14 remainder 2

Example 2

250 ÷ 11 = 22 remainder 8

Step	Data input operation	Read-out	Step	Data input operation	Read-out
	MODE 1	0.	7		
1	⟨Ex.1⟩ 100 ÷	100.	8		
2	7 PO	14.	9		
3	EXE	...2 2.	10		
4	⟨Ex.2⟩ AC 250 ÷	250.	11		
5	11 PO	22.	12		
6	EXE	...8 8.	13		

Remarks

Steps 3 and 6 display remainders.

Program for

Calculation of remainder

	Program	Remark	Step	Contents in memories
	MODE 3 2ndF MAC MODE 2			00
1	P0 Min 01 SHIFT X↔Y Min 02 SHIFT X↔Y = SHIFT INT HLT × MR 01		9	01
2	= M− 02 MR 02 "AL" · · α^{-s} # "AL"		18	02
3				03
4		Total 19		04
5				05
6				06
7				07
8				08
9				09
10				F
11				10
12				11
13				12
14				13
15				14
16				15
17				16
18				17
19				18
20				19
21				1F
22				20
23				21
24				22
25				23
26				24
27				25
28				26
29				27
30				28
31				29
32				2F
33				
34				
35				
36				
37				

Note

CASIO PROGRAM SHEET

Program for	No.	
Complex arithmetics	**Mathematics–4**	

Description

● Input the program written in page 9.

$z_1 = x_1 + iy_1$ ..... $r_1 = \sqrt{x_1^2 + y_1^2}$, $\theta_1 = \tan^{-1}\frac{y_1}{x_1}$

$z_2 = x_2 + iy_2$ ..... $r_2 = \sqrt{x_2^2 + y_2^2}$, $\theta_2 = \tan^{-1}\frac{y_2}{x_2}$

1. Sum and difference ⟶ [P0]

$z_1 + z_2 = (x_1 + x_2) + i(y_1 + y_2)$

$z_1 - z_2 = (x_1 - x_2) + i(y_1 - y_2)$

2. Product ⟶ [P1]

$z_1 \times z_2 \times \ldots \times z_n = R \cdot e^{i\theta} = (R \times \cos\theta) + i(R \times \sin\theta)$ $\left[\begin{array}{l} R = r_1 \times r_2 \times \ldots \times r_n \\ \theta = \theta_1 + \theta_2 + \ldots + \theta_n \end{array}\right]$

Input z_1 through z_n. Then operate [GoTo] [1]

to obtain x and y.

3. Quotient ⟶ [P2]

$$\frac{z_1}{z_2} = \frac{r_1}{r_2} \cdot e^{i(\theta_1 - \theta_2)} = \left\{\frac{r_1}{r_2} \times \cos(\theta_1 - \theta_2)\right\} + i\left\{\frac{r_1}{r_2} \times \sin(\theta_1 - \theta_2)\right\}$$

4. n-th power ⟶ [P3]

$z^n = r^n \cdot e^{in\theta} = (r^n \times \cos n\theta) + i(r^n \times \sin n\theta)$

5. n-th root ⟶ [P4]

$\sqrt[n]{z} = \sqrt[n]{r} \cdot e^{iA} = (\sqrt[n]{r} \times \cos A) + i(\sqrt[n]{r} \times \sin A)$

$$[A = \frac{\theta}{n} + \frac{360}{n}K \ (K = 0, 1, 2, \ldots\ldots, n-1)]$$

There are as many solution as "n" (k = 0, 1, ..., $n-1$)

Example

$z_1 = 2 + \sqrt{3}i$

$z_2 = 4 - i$

⟶

$z_1 + z_2 = 6 + 0.732i$

$z_1 - z_2 = -2 + 2.732i$

$z_1 \times z_2 = 9.732 + 4.928i$

$(z_1)^5 = -118 - 53.693i$

$(z_1)^{1/2} = -1.524 - 0.568i$

$1.524 + 0.568i$

Step	Data input operation	Read-out	Step	Data input operation	Read-out
	MODE 1	0.	11	3 SHIFT √ EXE	0.
1	P0	0.	12	4 EXE	0.
2	2 EXE	0.	13	1 +/- EXE	9.732050807 4.92820323
3	3 SHIFT √ EXE	0.	14	5 P3	0.
4	4 EXE	0.	15	2 EXE	0.
5	1 +/- EXE	6.	16	3 SHIFT √ EXE	−118 −53.69357503
6	EXE	0.732050807	17	2 P4	0.
7	EXE	−2.	18	2 EXE	0.
8	EXE	2.732050808	19	3 SHIFT √ EXE	−1.524098309 −0.568221484
9	P1	0.	20	EXE	1.524098309 0.568221484
10	2 EXE	0.	21		

Remarks

Step 5 displays (x) addition; Step 6 displays (y) addition; Step 7 displays (x) division; Step 8 displays (y) division; Steps 13, 16, 19, and 20 display (x) and (y).

Program for

Complex arithmetics

	Program	Remark	Step
	MODE 3 2ndF MAC MODE 2		
1	P0 AC		1
2	2ndF MAC HLT X-M 01 HLT X-M 02 HLT X-M 03 HLT X-M 04		10
3	MR 01 + MR 03 M- 01 = HLT MR 02 + MR 04 M- 02 = HLT		22
4	MR 01 HLT MR 02		25
5			
6	P1 AC		1
7	GSB SHIFT P8 GSB SHIFT P7 0 GSB SHIFT P8 SHIFT X-Y M+ 02		7
8	SHIFT X-Y × MR 01 = GSB SHIFT P9		12
9			
10	P2 AC		1
11	GSB SHIFT P8 GSB SHIFT P7 0 GSB SHIFT P8 SHIFT X-Y M- 02		7
12	SHIFT X-Y ÷ MR 01 SHIFT X-Y = GSB SHIFT P9		13
13			
14	P3 Min 00 AC GSB SHIFT P8 GSB SHIFT P7 MR 02 × MR 00 = Min 02		9
15	MR 01 SHIFT x^y MR 00 = GSB SHIFT P9		14
16			
17	P4 Min 00 MODE 4 AC GSB SHIFT P8 GSB SHIFT P7 MR 01 SHIFT $x^{\frac{1}{y}}$ MR 00 =		9
18	Min 01 MR 02 ÷ MR 00 = Min 02 3 6 0 ÷ MR 00 = Min 03		22
19	LBL 1 MR 03 M+ 02 MR 01 GSB SHIFT P9 HLT SHIFT DSZ GOTO 1		30
20			
21	SHIFT P7 Min 01 SHIFT X-Y Min 02		3
22			
23	SHIFT P8 HLT SHIFT R→P 0 HLT =		5
24			
25	SHIFT P9 SHIFT P→R MR 02 = SHIFT X-Y		4
26			
27		Total 114	
28			
29			
30			
31			
32			
33			
34			
35			
36			
37			

	Contents in memories
00	n
01	x^1 r
02	y^1 θ
03	x^2 360/n
04	y^2
05	
06	
07	
08	
09	
F	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
1F	
20	
21	
22	
23	
24	
25	
26	
27	
28	
29	
2F	

Remarks

Enter MODE 4 and specify DEG.

Program for

	Program	Remark	Step
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			
25			
26			
27			
28			
29			
30			
31			
32			
33			
34			
35			
36			
37			

Note

Contents in memories	
00	
01	
02	
03	
04	
05	
06	
07	
08	
09	
F	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
1F	
20	
21	
22	
23	
24	
25	
26	
27	
28	
29	
2F	

Program for

Complex arithmetics

	Program	Remark	Step
	MODE 3 2ndF MAC MODE 2		
1	P0 AC		1
2	2ndF MAC HLT X→M 01 HLT X→M 02 HLT X→M 03 HLT X→M 04		10
3	MR 01 + MR 03 M− 01 = HLT MR 02 + MR 04 M− 02 = HLT		22
4	MR 01 HLT MR 02		25
5			
6	P1 AC		1
7	GSB SHIFT P8 GSB SHIFT P7 0 GSB SHIFT P8 SHIFT X↔Y M+ 02		7
8	SHIFT X↔Y × MR 01 = GSB SHIFT P9		12
9			
10	P2 AC		1
11	GSB SHIFT P8 GSB SHIFT P7 0 GSB SHIFT P8 SHIFT X↔Y M− 02		7
12	SHIFT X↔Y ÷ MR 01 SHIFT X↔Y = GSB SHIFT P9		13
13			
14	P3 Min 00 AC GSB SHIFT P8 GSB SHIFT P7 MR 02 × MR 00 = Min 02		9
15	MR 01 SHIFT x^y MR 00 = GSB SHIFT P9		14
16			
17	P4 Min 00 MODE 4 AC GSB SHIFT P8 GSB SHIFT P7 MR 01 SHIFT $x^{\frac{1}{y}}$ MR 00 =		9
18	Min 01 MR 02 ÷ MR 00 = Min 02 3 6 0 ÷ MR 00 = Min 03		22
19	LBL 1 MR 03 M+ 02 MR 01 GSB SHIFT P9 HLT SHIFT DSZ GOTO 1		30
20			
21	SHIFT P7 Min 01 SHIFT X↔Y Min 02		3
22			
23	SHIFT P8 HLT SHIFT R→P 0 HLT =		5
24			
25	SHIFT P9 SHIFT P→R MR 02 = SHIFT X↔Y		4
26			
27		Total 114	
28			
29			
30			
31			
32			
33			
34			
35			
36			
37			

	Contents in memories
00	n
01	x^1 r
02	y^1 θ
03	x^2 360/n
04	y^2
05	
06	
07	
08	
09	
F	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
1F	
20	
21	
22	
23	
24	
25	
26	
27	
28	
29	
2F	

Remarks

Enter MODE 4 and specify DEG.

Program for

	Program	Remark	Step
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			
25			
26			
27			
28			
29			
30			
31			
32			
33			
34			
35			
36			
37			

Note

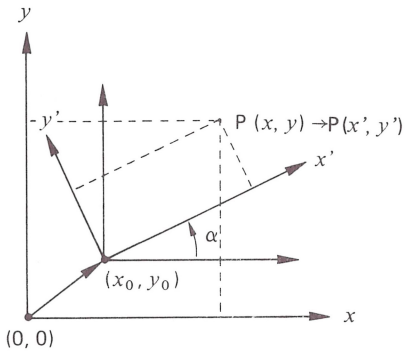
Contents in memories	
00	
01	
02	
03	
04	
05	
06	
07	
08	
09	
F	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
1F	
20	
21	
22	
23	
24	
25	
26	
27	
28	
29	
2F	

CASIO PROGRAM SHEET

Program for	No.	
Transformation of coordinates	Mathematics-5	

Description

• Input the program written in the next page.



$$P(x, y) \rightarrow P(x', y')$$

$$x' = (x - x_0)\cos\alpha + (y - y_0)\sin\alpha$$

$$y' = (y - y_0)\cos\alpha - (x - x_0)\sin\alpha$$

Example

$P(5, 5) \rightarrow (x_0, y_0) = (3, 2) / \alpha = 20°$

what is $P(x', y')$?

Step	Data input operation	Read-out	Step	Data input operation	Read-out
	MODE 1	0.	7	EXE	y, = 2.135037576
1	PO	x=0? 0.	8		
2	5 EXE	y=0? 0.	9		
3	5 EXE	x0=0? 0.	10		
4	3 EXE	y0=0? 0.	11		
5	2 EXE	a=0? 0.	12		
6	20 EXE	x, = 2.905445672	13		

Remarks

Program for

Transformation of coordinates

	Program	Remark	Step
	MODE 3 2ndF MAC MODE 2		
1	PO 2ndF MAC ▷		1
2	LBL 1 ▷ MR 01 ▷ "AL▷ x ▷ = ▷ α-S # ▷ α-S ? ▷ AL" ▷ HLT ▷		10
3	Min 01 ▷		11
4	MR 02 ▷ "AL▷ y ▷ = ▷ α-S # ▷ α-S ? ▷ AL" ▷ HLT ▷		19
5	Min 02 ▷		20
6	MR 03 ▷ "AL▷ x ▷ 0 ▷ = ▷ α-S # ▷ α-S ? ▷ AL" ▷ HLT ▷		29
7	Min 03 ▷		30
8	MR 04 ▷ "AL▷ y ▷ 0 ▷ = ▷ α-S # ▷ α-S ? ▷ AL" ▷ HLT ▷		39
9	Min 04 ▷		40
10	MR 05 ▷ "AL▷ a ▷ = ▷ α-S # ▷ α-S ? ▷ AL" ▷ HLT ▷		48
11	Min 05 ▷		49
12	MR 01 ▷ − ▷ MR 03 ▷ = ▷ Min 06 ▷ MR 02 ▷ − ▷ MR 04 ▷ = ▷		58
13	Min 07 ▷ MR 06 ▷ × ▷ MR 05 ▷ cos ▷ + ▷ MR 07 ▷ × ▷ MR 05 ▷ sin ▷		68
14	= ▷ "AL▷ x ▷ α-S , ▷ = ▷ AL" ▷ HLT ▷		75
15	MR 07 ▷ × ▷ MR 05 ▷ cos ▷ − ▷ MR 06 ▷ × ▷ MR 05 ▷ sin ▷ = ▷		85
16	"AL▷ y ▷ α-S , ▷ = ▷ AL" ▷ HLT ▷ GOTO 1 ▷		92
17			
18		Total 93	
19			
20			
21			
22			
23			
24			
25			
26			
27			
28			
29			
30			
31			
32			
33			
34			
35			
36			
37			

Note

	Contents in memories
00	
01	x
02	y
03	x_0
04	y_0
05	a
06	$x - x_0$
07	$y - y_0$
08	
09	
F	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
1E	F
20	
21	
22	
23	
24	
25	
26	
27	
28	
29	
2F	

CASIO PROGRAM SHEET

Program for	No.	
4-by-4 determinant	Mathematics–6	

Description

• Input the program written in the next page.

$$A = \begin{vmatrix} a_{11} & a_{12} & a_{13} & a_{14} \\ a_{21} & a_{22} & a_{23} & a_{24} \\ a_{31} & a_{32} & a_{33} & a_{34} \\ a_{41} & a_{42} & a_{43} & a_{44} \end{vmatrix}$$

$$= (a_{11}a_{22} - a_{12}a_{21})(a_{33}a_{44} - a_{34}a_{43}) + (a_{13}a_{21} - a_{11}a_{23})(a_{32}a_{44} - a_{34}a_{42})$$
$$+ (a_{11}a_{24} - a_{14}a_{21})(a_{32}a_{43} - a_{33}a_{42}) + (a_{12}a_{23} - a_{13}a_{22})(a_{31}a_{44} - a_{34}a_{41})$$
$$+ (a_{14}a_{22} - a_{12}a_{24})(a_{31}a_{43} - a_{33}a_{41}) + (a_{13}a_{24} - a_{14}a_{23})(a_{31}a_{42} - a_{32}a_{41})$$

Example

$$A = \begin{vmatrix} 2 & 0 & 1 & 3 \\ -1 & 2 & -1 & 1 \\ 0 & 1 & 0 & -2 \\ 1 & -3 & 2 & 1 \end{vmatrix} = 13$$

Step	Data input operation	Read-out	Step	Data input operation	Read-out
	MODE 1	0.	9	3 +/- EXE	a 1 3 ? 0.
1	PO	a 1 1 ? 0.	10	1 EXE	a 2 3 ? 0.
2	2 EXE	a 2 1 ? 0.	11	1 +/- EXE	a 3 3 ? 0.
3	1 +/- EXE	a 3 1 ? 0.	12	EXE	a 4 3 ? 0.
4	EXE	a 4 1 ? 0.	13	2 EXE	a 1 4 ? 0.
5	1 EXE	a 1 2 ? 0.	14	3 EXE	a 2 4 ? 0.
6	EXE	a 2 2 ? 0.	15	1 EXE	a 3 4 ? 0.
7	2 EXE	a 3 2 ? 0.	16	2 +/- EXE	a 4 4 ? 0.
8	1 EXE	a 4 2 ? 0.	17	1 EXE	A= 13.

Remarks

Program for

4-by-4 determinant

	Program	Remark	Step	Contents in memories	
	MODE 3 2ndF MAC MODE 2			00	
1	PO 2ndF MAC		1	01	a_{11}
2	LBL 1 1 M+ F		4	02	a_{21}
3	LBL 2 1 0 M+ F SHIFT ISZ AC "AL a α-s AR F α-s ?		14	03	a_{31}
4	AL" HLT SHIFT IND Min 00 4 0 SHIFT $x \geq$ F GOTO 2 GOTO 3		23	04	a_{41}
5	LBL 3 4 0 M− F 4 SHIFT $x=$F GOTO 4 GOTO 1		31	05	a_{12}
6	LBL 4 0 Min 19		34	06	a_{22}
7	MR 16 × MR 11 − MR 12 × MR 15 = Min 17		43	07	a_{32}
8	MR 06 × MR 01 − MR 02 × MR 05 = Min 18		52	08	a_{42}
9	GSB P1		53	09	a_{43}
10	MR 08 × MR 15 − MR 16 × MR 07 = Min 17		62	F	
11	MR 10 × MR 01 − MR 02 × MR 09 = Min 18		71	10	a_{23}
12	GSB P1		72	11	a_{33}
13	MR 16 × MR 03 − MR 04 × MR 15 = Min 17		81	12	a_{34}
14	MR 10 × MR 05 − MR 06 × MR 09 = Min 18		90	13	a_{44}
15	GSB P1		91	14	a_{24}
16	MR 12 × MR 07 − MR 08 × MR 11 = Min 17		100	15	a_{34}
17	MR 14 × MR 01 − MR 02 × MR 13 = Min 18		109	16	a_{44}
18	GSB P1		110	17	
19	MR 04 × MR 11 − MR 12 × MR 03 = Min 17		119	18	
20	MR 14 × MR 05 − MR 06 × MR 13 = Min 18		128	19	
21	GSB P1		129	1F	
22	MR 08 × MR 03 − MR 04 × MR 03 = Min 17		138	20	
23	MR 14 × MR 09 − MR 10 × MR 13 = Min 18		147	21	
24	GSB P1		148	22	
25	"AL A = AL"		152	23	
26				24	
27	P1 MR 17 × MR 18 = M+ 19		5	25	
28				26	
29		Total 159		27	
30				28	
31				29	
32				2F	
33					
34					
35					
36					
37					

Note

CASIO PROGRAM SHEET

Program for	No.	
3 variable linear equations	Mathematics-7	

Description

• Input the program written in the next page.

$$a_1x + b_1y + c_1z = d_1 \quad \text{(1)}$$

$$a_2x + b_2y + c_2z = d_2 \quad \text{(2)}$$

$$a_3x + b_3y + c_3z = d_3 \quad \text{(3)}$$

$$x = \frac{\begin{vmatrix} d_1 & b_1 & c_1 \\ d_2 & b_2 & c_2 \\ d_3 & b_3 & c_3 \end{vmatrix}}{\begin{vmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{vmatrix}} \qquad y = \frac{\begin{vmatrix} a_1 & d_1 & c_1 \\ a_2 & d_2 & c_2 \\ a_3 & d_3 & c_3 \end{vmatrix}}{\begin{vmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{vmatrix}} \qquad z = \frac{d_1 - a_1x - b_1y}{c_1}$$

Example

$$x + y + z = 6$$

$$2x + 2y + z = 9$$

$$-x + y + z = 4$$

Step	Data input operation	Read-out	Step	Data input operation	Read-out
	MODE 1	0.	8	1 EXE	d 2 ? 1.
1	PO	a 1 ? 1.	9	9 EXE	a 3 ? 1.
2	1 EXE	b 1 ? 1.	10	1 +/- EXE	b 3 ? −1.
3	EXE	c 1 ? 1.	11	1 EXE	c 3 ? 1.
4	EXE	d 1 ? 1.	12	EXE	d 3 ? 1.
5	6 EXE	a 2 ? 1.	13	4 EXE	x = 1.
6	2 EXE	b 2 ? 2.	14	EXE	y = 2.
7	EXE	c 2 ? 2.	15	EXE	z = 3.

Remarks

Program for

3 variable linear equations

	Program	Remark	Step	Contents in memories	
	MODE 3 2ndF MAC MODE 2			00	
1	PO 2ndF MAC 1 2 Min 00 AC		5	01	d_3
2	LBL 1 1 M+ F		8	02	c_3
3	"AL a α-s AR F α-s ? "AL" HLT SHIFT IND		15	03	b_3
4	Min 00 SHIFT DSZ		17	04	a_3
5	"AL b α-s AR F α-s ? "AL" HLT SHIFT IND		24	05	d_2
6	Min 00 SHIFT DSZ		26	06	c_2
7	"AL c α-s AR F α-s ? "AL" HLT SHIFT IND		33	07	b_2
8	Min 00 SHIFT DSZ		35	08	a_2
9	"AL d α-s AR F α-s ? "AL" HLT SHIFT IND		42	09	d_1
10	Min 00 SHIFT DSZ GOTO 1		45	F	
11	1 3 Min 13 GSB P2 4 Min 17 1 GSB SHIFT P5 GSB P2		54	10	c_1
12	1 Min 17 3 GSB SHIFT P5 3 Min 17 4 GSB SHIFT P5		62	11	b_1
13	GSB P2 MR 15 ÷ MR 14 = Min 17 "AL x =		71	12	a_1
14	AL" HLT		73	13	
15	MR 16 ÷ MR 14 = Min 18 "AL y =		81	14	
16	AL" HLT		83	15	
17	(MR 11 − MR 17 × MR 12 − MR 18 × MR 09		93	16	
18	) ÷ MR 10 = "AL z = AL"		101	17	x
19				18	y
20	P1 MR 12 × MR 07 × MR 02 + MR 11 × MR 06		9	19	
21	× MR 04 + MR 10 × MR 08 × MR 03 − (MR 10		20	1F	
22	× MR 07 × MR 04 + MR 06 × MR 03 × MR 12 +		31	20	
23	MR 02 × MR 11 × MR 08) = SHIFT IND Min 13		40	21	
24				22	
25	P2 1 M+ 13 GSB P1		3	23	
26				24	
27	P3 SHIFT IND MR 17 Min F SHIFT IND MR 18 SHIFT IND Min 17		7	25	
28	MR F SHIFT IND Min 18		10	26	
29				27	
30	P4			28	
31	LBL 1 4 M+ 17 M+ 18 GSB P3 SHIFT DSZ GOTO 1		7	29	
32				2F	
33	SHIFT P5 Min 18 2 Min 00 GSB P3 GSB P4		5		
34					
35		Total 172			
36					
37					

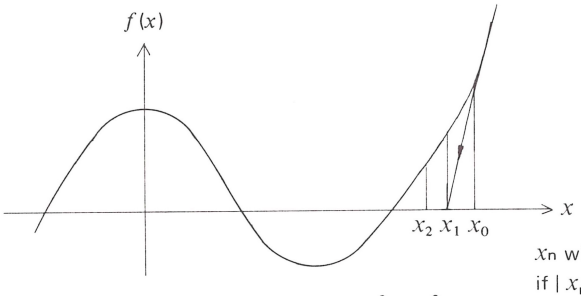
Note

CASIO PROGRAM SHEET

Program for	No.	
Solving a cubic equation by the Newton method	**Mathematics-8**	

Description

• Input the program written in the next page.



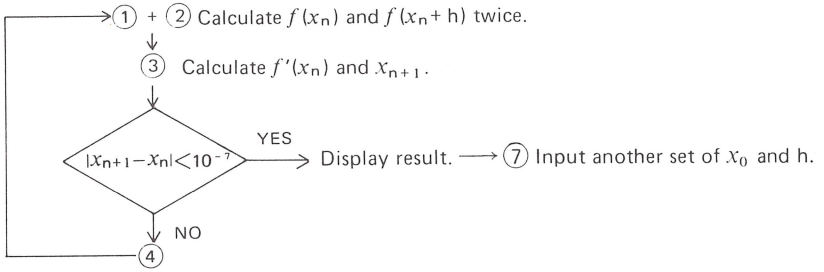
$$x_{n+1} = x_n - \frac{f(x_n)}{f'(x_n)}$$

$$f'(x) = \frac{f(x+h) - f(x)}{h}$$

x_n will be taken as an approximate solution if $|x_{n+1} - x_n| < \epsilon_0$.

$$f(x) = ax^3 + bx^2 + cx + d$$

< Flowchart >



Example

$f(x) = x^3 + x^2 - x - 1$

$x_0 = 0$, $\epsilon_0 = 1 \times 10^{-7}$, $h = 0.01$

Step	Data input operation	Read-out	Step	Data input operation	Read-out
	MODE 1	0.	7	2 EXE	h ? 2.
1	PO	a ? 0.	8	0.01 EXE	x = 1.00000002
2	1 EXE	b ? 1.	9		
3	EXE	c ? 1.	10		
4	1 +/- EXE	d ? −1.	11		
5	EXE	E0 ? −1.	12		
6	1 EXP 7 +/- EXE	x0 ? 1. −07	13		

Remarks

Program for **Solving a cubic equation by the Newton method**

	Program	Remark	Step
	MODE 3 2nd MAC MODE 2		
1	PO"AL a α-s ?AL"HLT Min 01		6
2	"AL b α-s ?AL"HLT Min 02		12
3	"AL c α-s ?AL"HLT Min 03		18
4	"AL d α-s ?AL"HLT Min 04		24
5	"AL CAPS E 0 α-s ?AL"HLT Min F		31
6	LBL 1 "AL CAPS x 0 α-s ?AL"HLT Min 05		39
7	"AL CAPS h α-s ?AL"HLT Min 06		45
8	LBL 2 MR 05 Min 07 2 Min 00		50
9	LBL 3 MR 01 × MR 05 SHIFT x^2 × MR 05 + MR 02 ×		60
10	MR 05 SHIFT x^2 + MR 03 × MR 05 + MR 04 =		69
11	Min 09 MR 06 M+ 05		72
12	SHIFT DSZ GOTO 4		74
13	GOTO 5		75
14	LBL 4 MR 09 Min 08 GOTO 3		79
15	LBL 5 (MR 09 − MR 08) ÷ MR 06 = Min 09		89
16	MR 07 − MR 08 ÷ MR 09 = Min 08 − MR 07		98
17	= SHIFT ABS SHIFT $x \geq$ f GOTO 6 GOTO 7		103
18	LBL 6 MR 08 Min 05 GOTO 2		107
19	LBL 7 "AL x = AL" MR 07		113
20			
21		Total 114	
22			
23			
24			
25			
26			
27			
28			
29			
30			
31			
32			
33			
34			
35			
36			
37			

Contents in memories	
00	
01	a
02	b
03	c
04	d
05	$x_0 \rightarrow x_n + h$
06	h
07	$x_0 \rightarrow x_n$
08	$f(x_n) \rightarrow x_{n+1}$
09	$f(x_n+h) \rightarrow f'(x_n)$
F	ε_0
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
1F	
20	
21	
22	
23	
24	
25	
26	
27	
28	
29	
2F	

Note

If " − " remains displayed perpetually the approximation does not converge because start point x_0 is wrong. Depress HLT, GOTO 1, change the value of x_0 and repeat operation from step 7.

CASIO PROGRAM SHEET

Program for	No.	
Definite integral by the Simpson's rule	**Mathematics–9**	

Description

• Input the program written in the next page.

$$I = \int_a^b f(x)dx = \frac{h}{3}\left\{y_0 + 4(y_1 + y_3 + \ldots + y_{2m-1}) + 2(y_2 + y_4 + \cdots y_{2m-2}) + y_{2m}\right\}$$

$$h = \frac{b-a}{2m}$$

The right-hand side of the above equation can be transformed as follows.

$$I = \frac{h}{3}\left\{y_0 + \sum_{i=1}^{m}(4y_{2i-1} + 2y_{2i}) - y_{2m}\right\}$$

Let $f(x) = \dfrac{1}{x^2+1}$

Example 1 $a = 0$, b = 1, $2m = 10$

$$I = \int_0^1 \frac{1}{x^2+1}dx = 0.785398152$$

Example 2 $a = 2$, b = 5, $2m = 20$

$$I = \int_2^5 \frac{1}{x^2+1}dx = 0.266252676$$

Step	Data input operation	Read-out	Step	Data input operation	Read-out
	MODE 1	0.	7	5 EXE	2m? 5.
1	<Ex.1> PO	a ? 0.	8	20 EXE	I = 0.266252676
2	0 EXE	b ? 0.	9		
3	1 EXE	2m? 1.	10		
4	10 EXE	I = 0.785398153	11		
5	<Ex.2> PO	a ? 0.	12		
6	2 EXE	b ? 2.	13		

Remarks

Program for **Definite integral by the Simpson's rule**

	Program	Remark	Step
	MODE 3 2ndF MAC MODE 2		
1	P0		
2	LBL 1 ,"AL, a ,$^{\alpha-s}$? ,AL",HLT ,Min01,		7
3	"AL, b ,$^{\alpha-s}$? ,AL",HLT ,Min02,		13
4	"AL, 2 ,m ,$^{\alpha-s}$? ,AL",HLT ,Min03,		20
5	MR01,Min07,GSBP1,Min09,		24
6	(,MR02, − ,MR01,) , ÷ ,MR03, = ,Min04,		33
7	MR03, ÷ , 2 , = ,Min00,		38
8	LBL 2 MR04,M+07,GSBP1, × , 4 , = ,M+09,		46
9	MR04,M+07,GSBP1, × , 2 , = ,M+09,		53
10	SHIFT DSZ,GOTO 2 ,		55
11	MR02,Min07,GSBP1,M−09,		59
12	MR04, × ,MR09, ÷ , 3 , = ,		65
13	"AL, I , = ,AL",		69
14			
15	P1MR07, SHIFT x^2 , + , 1 , = , SHIFT $1/x$,		6
16			
17		Total 77	
18			
19			
20			
21			
22			
23			
24			
25			
26			
27			
28			
29			
30			
31			
32			
33			
34			
35			
36			
37			

Note

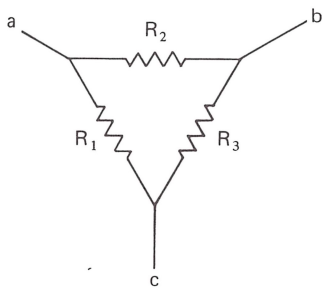
	Contents in memories
00	Numder of repetitions
01	a
02	b
03	2m
04	$h = \frac{b-a}{2m}$
05	
06	
07	x
08	
09	I
F	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
1F	
20	
21	
22	
23	
24	
25	
26	
27	
28	
29	
2F	

CASIO PROGRAM SHEET

Program for	No.
△ ↔ Y conversion	Electrical engineering–1

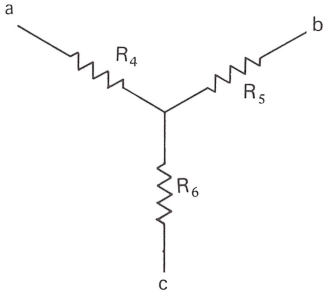
Description

• Input the program written in the next page.



P_1 →

← P_2



1) △ → Y

$$R_4 = \frac{R_1 \cdot R_2}{R_1 + R_2 + R_3}$$

$$R_5 = \frac{R_2 \cdot R_3}{R_1 + R_2 + R_3}$$

$$R_6 = \frac{R_3 \cdot R_1}{R_1 + R_2 + R_3}$$

2) Y → △

$$R_1 = \frac{R_4R_5 + R_5R_6 + R_6R_4}{R_5}$$

$$R_2 = \frac{R_4R_5 + R_5R_6 + R_6R_4}{R_6}$$

$$R_3 = \frac{R_4R_5 + R_5R_6 + R_6R_4}{R_4}$$

Example

Example 1

$R_1 = 12\ (\Omega)$
$R_2 = 47\ (\Omega)$
$R_3 = 82\ (\Omega)$

Example 2

$R_4 = 100\ (\Omega)$
$R_5 = 150\ (\Omega)$
$R_6 = 220\ (\Omega)$

Step	Data input operation	Read-out
	MODE 1	0.
1	⟨Ex.1⟩ P1	INPUT R1 ? 1.
2	12 EXE	INPUT R2 ? 12.
3	47 EXE	INPUT R3 ? 47.
4	82 EXE	ANS R4 4.
5	EXE	ANS R5 27.33333333
6	EXE	ANS R6 6.978723404

Step	Data input operation	Remark
7	⟨Ex.2⟩ P2	INPUT R4 ? 4.
8	100 EXE	INPUT R5 ? 100.
9	150 EXE	INPUT R6 ? 150.
10	220 EXE	ANS R1 466.6666667
11	EXE	ANS R2 318.1818182
12	EXE	ANS R3 700.
13		

Remarks

Step 1 is △ → Y conversion; Step 7 is Y → △ conversion.

Program for

△ ⟷ Y Conversion

	Program	Remark	Step
	MODE 3 2ndF MAC MODE 2		
1	P1	△→Y	
2	LBL 1 ‖ 1 ‖ Min00 ‖ GSB P3 ‖ HLT ‖		5
3	GSB SHIFT P5 ‖ GSB P3 ‖ HLT ‖ GSB SHIFT P5 ‖ GSB P3 ‖ HLT ‖		11
4	GSB SHIFT P5 ‖ MR 01 ‖ + ‖ MR 02 ‖ + ‖ MR 03 ‖ = ‖ Min 07 ‖	$R_4+R_2+R_3$	19
5	GSB P4 ‖ MR 01 ‖ × ‖ MR 02 ‖ ÷ ‖ MR 07 ‖ = ‖ HLT ‖	R_4	27
6	GSB P4 ‖ MR 02 ‖ × ‖ MR 03 ‖ ÷ ‖ MR 07 ‖ = ‖ HLT ‖	R_5	35
7	GSB P4 ‖ MR 03 ‖ × ‖ MR 01 ‖ ÷ ‖ MR 07 ‖ = ‖ HLT ‖ GOTO 1 ‖	R_6	44
8			
9	P2	Y→△	
10	LBL 1 ‖ 4 ‖ Min00 ‖ GSB P3 ‖ HLT ‖		5
11	GSB SHIFT P5 ‖ GSB P3 ‖ HLT ‖ GSB SHIFT P5 ‖ GSB P3 ‖ HLT ‖		11
12	GSB SHIFT P5 ‖ 1 ‖ Min00 ‖ MR 04 ‖ × ‖ MR 05 ‖ + ‖ MR 05 ‖ × ‖		20
13	MR 06 ‖ + ‖ MR 06 ‖ × ‖ MR 04 ‖ = ‖ Min 08 ‖	$R_4R_5+R_5R_6+R_6R_4$	27
14	GSB P4 ‖ MR 08 ‖ ÷ ‖ MR 05 ‖ = ‖ HLT ‖	R_1	33
15	GSB P4 ‖ MR 08 ‖ ÷ ‖ MR 06 ‖ = ‖ HLT ‖	R_2	39
16	GSB P4 ‖ MR 08 ‖ ÷ ‖ MR 04 ‖ = ‖ HLT ‖ GOTO 1 ‖	R_3	46
17			
18	P3		
19	"AL ‖ CAPS ‖ ‖ N ‖ P ‖ U ‖ T ‖ α-s SPACE ‖ R ‖ α-s AR 00 ‖ α-s SPACE ‖	Input display	10
20	α-s ? ‖ AL" ‖		12
21			
22	P4		
23	"AL ‖ A ‖ N ‖ S ‖ α-s SPACE ‖ R ‖ α-s AR 00 ‖ AL" ‖	Output display	8
24	SHIFT ISZ ‖		9
25			
26	SHIFT P5		
27	SHIFT IND ‖ Min00 ‖ SHIFT ISZ ‖		3
28			
29		Total 119	
30			
31			
32			
33			
34			
35			
36			
37			

	Contents in memories
00	For Rn display
01	R_1
02	R_2
03	R_3
04	R_4
05	R_5
06	R_6
07	$R_1+R_2+R_3$
08	$R_4R_5+R_5R_6+R_6R_4$
09	
F	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
1F	
20	
21	
22	
23	
24	
25	
26	
27	
28	
29	
2F	

Note

Input display: ''INPUT Rn?'' is displayed.

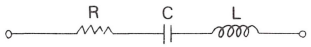
CASIO PROGRAM SHEET

Program for	No.
Inpedance of series and parallel circuits	Electrical engineering-2

Description

• Input the program written in the next page.

1. Series → P0



$$Z = R + j\left(\omega L - \frac{1}{\omega C}\right) = x + jy$$

$$|Z| = \sqrt{R^2 + \left(\omega L - \frac{1}{\omega C}\right)^2}$$

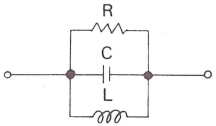
$$\theta = \tan^{-1}\left(\frac{\omega L - \frac{1}{\omega C}}{R}\right)$$

R [Ω] L [mH]

C [μF] f [Hz]

where $\omega = 2\pi f$

2. Parallel → P5



$$Z = \frac{1}{\frac{1}{R} + j\left(\omega C - \frac{1}{\omega L}\right)}$$

$$= \frac{\frac{1}{R} - j\left(\omega C - \frac{1}{\omega L}\right)}{\frac{1}{R^2} + \left(\omega C - \frac{1}{\omega L}\right)^2} = x + jy$$

$$|Z| = \frac{1}{\sqrt{\frac{1}{R^2} + \left(\omega C - \frac{1}{\omega L}\right)^2}}$$

$$\theta = \tan^{-1} R\left(\frac{1}{\omega L} - \omega C\right)$$

Example

1. Series
   R = 10 (Ω)
   C = 5 (μF)
   L = 20 (mH)
   f = 60 (Hz)

2. Parallel
   R = 47 (Ω)
   C = 1 (μF)
   L = 30 (mH)
   f = 50 (Hz)

Step	Data input operation	Read-out
	MODE 1	0.
1	<Ex.1> 10 P1	R 10.
2	5 P2	C 5. -06
3	20 P3	L 0.02
4	60 P4	2πf 376.9911184
5	P0	x 10.
6	EXE	y -522.9766546
7	EXE	Z 523.0722524
8	EXE	Phase -88.90456299

Step	Data input operation	Read-out
9	<Ex.2> 47 P1	R 47.
10	1 P2	C 1. -06
11	30 P3	L 0.03
12	50 P4	2πf 314.1592654
13	SHIFT P5	x 1.82725284
14	EXE	y 9.085264472
15	EXE	Z 9.267193937
16	EXE	Phase 78.6282295
17		

Remarks

Step 13 displays Parallel x.

Program for

Impedance of series and parallel circuits

	Program	Remark	Step	Contents in memories	
	MODE 3 2ndF MAC MODE 2			00	
1	P0 "AL CAPS S CAPS E R I E CAPS S AL"	Series	8	01	R
2	SHIFT PAUSE MR 01 Min06		11	02	C
3	MR05 × MR 03 − MR 05 SHIFT $1/x$ ÷ MR 02		19	03	L
4	GSB SHIFT P6		20	04	f
5				05	$\omega = 2\pi f$
6	SHIFT P5 "AL CAPS P CAPS A R A L L E L AL"	Parallel	10	06	x
7	SHIFT PAUSE MR 05 × MR 02 − MR 05 SHIFT $1/x$ ÷		18	07	y
8	MR 03 = Min08		21	08	$\omega c - \frac{1}{\omega L}$
9	SHIFT x^2 + MR 01 SHIFT $1/x$ SHIFT x^2 = Min09		28	09	$(\omega c - \frac{1}{\omega L})^2 + \frac{1}{R^2}$
10	× MR 01 = SHIFT $1/x$ Min06		33	F	
11	MR 08 +/− ÷ MR09 GSB SHIFT P6		38	10	
12				11	
13	SHIFT P6 = Min 07 "AL X AL" MR06 HLT	Answer output	7	12	
14	SHIFT R→P "AL Y AL" MR07 HLT		13	13	
15	"AL CAPS Z AL" SHIFT = HLT		18	14	
16	"AL P CAPS H A S E AL"		25	15	
17	SHIFT X↔Y		26	16	
18				17	
19	P1 "AL CAPS R AL" SHIFT PAUSE Min 01		5	18	
20				19	
21	P2 "AL C AL" SHIFT PAUSE EXP 6 +/− Min02		8	1F	
22		Data input		20	
23	P3 "AL L AL" SHIFT PAUSE EXP 3 +/− Min03		8	21	
24				22	
25	P4 "AL 2 SHIFT π f AL" SHIFT PAUSE Min04		7	23	
26	× 2 × SHIFT π = Min 05		13	24	
27				25	
28		Total 125		26	
29				27	
30				28	
31				29	
32				2F	
33					
34					
35					
36					
37					

Note

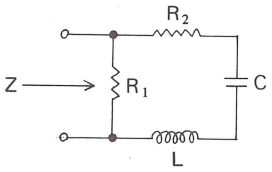
R, C, L and $2\pi f$ will be displayed after each data is input.

CASIO PROGRAM SHEET

Program for	No.
Impedance of series resonance circuit	**Electrical engineering–3**

Description

• Input the program written in the next page.



Resonance frequency $f_0 = \dfrac{1}{2\pi\sqrt{LC}}$

$$\frac{1}{Z} = \frac{1}{R_1} + \frac{1}{R_2 + j(\omega L - \frac{1}{\omega C})} \qquad \omega = 2\pi f$$

$$Z = \frac{R_1 R_2 (R_1 + R_2) + R_1 (\omega L - \frac{1}{\omega C})^2 + j R_1^2 (\omega L - \frac{1}{\omega C})}{(R_1 + R_2)^2 + (\omega L - \frac{1}{\omega C})^2} = x + jy$$

$$|Z| = \sqrt{x^2 + y^2}$$

$$\theta = \tan^{-1}\frac{y}{x}$$

R = [Ω] L = [mH]

C = [μF] f = [Hz]

Example

R_1 = 20 (Ω) L = 20 (mH)

R_2 = 15 (Ω) f = 60 (Hz)

C = 0.5 (μF) Calculate f_0 of this resonance cirucit.

Step	Data input operation	Read-out	Step	Data input operation	Read-out
	MODE 1	0.	7	60 EXE	x = 19.99950118
1	PO	R 1 0.	8	EXE	y = −0.075502238
2	20 EXE	R 2 20.	9	EXE	Z = 19.99964369
3	15 EXE	C 15.	10	EXE	Phase = −0.216302347
4	0.5 EXE	L 5. −07	11		
5	20 EXE	f 0 = 1592.	12		
6		f 1592.	13		

Remarks

Step 5 displays pause; Step 10 displays (θ).

Program for

Inpedance of series resonance circuit

	Program	Remark	Step
	MODE 3 2ndF MAC MODE 2		
1	PO"AL₁ CAPS R₁ 1 ₁AL"₁HLT₁Min 01₁		6
2	"AL₁ R₁ 2 ₁AL"₁HLT₁Min02₁		12
3	"AL₁ C ₁AL"₁HLT₁EXP₁ 6 ₁+/-₁Min03₁		20
4	"AL₁ L ₁AL"₁HLT₁EXP₁ 3 ₁+/-₁Min04₁		28
5	×₁MR 03₁=₁ SHIFT √ ₁×₁ 2 ₁×₁ SHIFT π ₁=₁ SHIFT 1/x₁		38
6	SHIFT RND 4 ₁Min F₁		40
7	"AL₁ CAPS f ₁ 0 ₁=₁AL"; SHIFT PAUSE₁	f_0	46
8	"AL₁ f ₁AL"₁HLT₁ ×₁ 2 ₁×₁ SHIFT π ₁=₁Min 05₁		56
9	×₁MR 04₁−₁MR 05₁ SHIFT 1/x₁ ÷₁MR 03₁=₁Min06₁		65
10	MR 01₁+₁MR 02₁=₁Min 07₁ SHIFT $x^2$₁+₁MR 06₁ SHIFT $x^2$₁		74
11	=₁Min 00₁		76
12	MR 01₁×₁ (₁MR 02₁×₁MR 07₁+₁MR 06₁ SHIFT $x^2$₁) ₁		86
13	÷₁MR 00₁=₁		89
14	"AL₁ X ₁=₁AL"₁Min 08₁HLT₁	x	94
15	SHIFT R→P₁ (₁MR 01₁ SHIFT $x^2$₁×₁MR 06₁÷₁MR 00₁) ₁		103
16	"AL₁ y ₁=₁AL"₁Min09₁HLT₁	y	108
17	"AL₁ CAPS Z ₁=₁AL"₁HLT₁	z	114
18	"AL₁ P₁ CAPS h₁ a₁ s₁ e₁=₁AL"₁	θ	122
19	SHIFT X↔Y₁		123
20			
21		Total 124	
22			
23			
24			
25			
26			
27			
28			
29			
30			
31			
32			
33			
34			
35			
36			
37			

	Contents in memories
00	$(R_1+R_2)^2+(\omega L-\frac{1}{\omega C})^2$
01	R_1
02	R_2
03	C
04	L
05	$\omega=2\pi f$
06	$\omega L-\frac{1}{\omega C}$
07	R_1+R_2
08	x
09	y
F	f_0
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
1F	
20	
21	
22	
23	
24	
25	
26	
27	
28	
29	
2F	

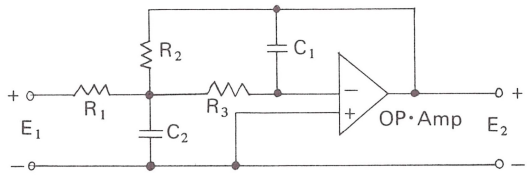
Note

CASIO PROGRAM SHEET

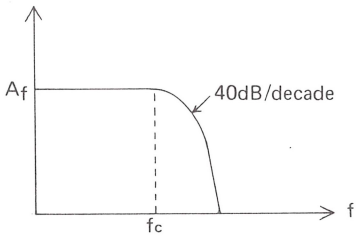
Program for	No.
Design of an active low-pass filter	Electrical engineering–4

Description

• Input the program written in the next page.



$$\frac{E_2}{E_1} = \frac{-H\omega_0^2}{S^2 + \alpha\omega_0 S + \omega_0^2}$$



$H = A_f$

$\omega_0 = 2\pi f_0 \qquad \alpha = \sqrt{2}$

$$R_1 = \frac{\sqrt{2}}{2 \times A_f \times 2\pi f_c \times C_1}$$

$R_2 = A_f R_1$

$$R_3 = \frac{R_2}{A_f + 1}$$

$C_2 = 2(A_f + 1)\, C_1$

R [Ω] $\qquad$ f_c [Hz]

C [μF]

A_f [in times]

Example

Calculate the values of R_1, R_2, R_3 and C_2 to make up a low-pass filter with f_c = 200 Hz, A_f = 10 times and C_1= 5μF.

Step	Data input operation	Read-out	Step	Data input operation	Read-out
	MODE 1	0.	7	EXE	ANS C2(μF) 110.
1	PO	fc(Hz) ? 0.	8		
2	200 EXE	Af ? 200.	9		
3	10 EXE	C1(μF) ? 10.	10		
4	5 EXE	ANS R1(Ohm) 11.25395395	11		
5	EXE	ANS R2(Ohm) 112.5395395	12		
6	EXE	ANS R3(Ohm) 10.23086723	13		

Remarks

Program for

Design of an active low-pass filter

	Program	Remark	Step
	MODE 3 2nd MAC MODE 2		
1	P0		
2	LBL 1 "AL f C (CAPS H CAPS Z) SPACE		9
3	? "AL" HLT Min 01		13
4	"AL CAPS A CAPS f SPACE ? "AL" HLT Min 02	Data input	21
5	"AL CAPS C 1 (μ F) SPACE ?		30
6	AL" HLT EXP 6 +/- Min 03		36
7	1 Min 00 GSB P1		39
8	2 × SHIFT π × MR 01 = Min 04	$2\pi fc$	46
9	2 SHIFT √ × MR 02 × MR 04 × MR 03 = SHIFT 1/x	R_1	56
10	HLT		57
11	GSB P1 × MR 02 = HLT	R_2	62
12	GSB P1 ÷ (MR 02 + 1) = HLT	R_3	71
13	"AL A N S SPACE C 2 (μ F	C_2	81
14	) "AL" 2 × (MR 02 + 1)		90
15	× MR 03 × 1 EXP 6 = HLT GOTO 1		99
16			
17	P1 "AL CAPS A N S SPACE R AR00 (O	ANS Rn display	9
18	CAPS h m)· "AL" SHIFT ISZ		15
19			
20		Total 116	
21			
22			
23			
24			
25			
26			
27			
28			
29			
30			
31			
32			
33			
34			
35			
36			
37			

	Contents in memories
00	For Rn display
01	fc
02	A_f
03	C_1
04	$2\pi fc$
05	
06	
07	
08	
09	
F	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
1F	
20	
21	
22	
23	
24	
25	
26	
27	
28	
29	
2F	

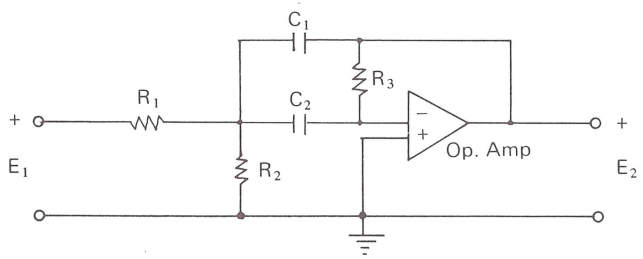
Note

CASIO PROGRAM SHEET

Program for	No.
Design of an active band-pass filter	Electrical engineering–5

Description

● Input the program written in the next page.



f_0 : Center frequency of pass band

Q : Resonance sharpness

A_0 : Loop gain

$$R_1 = \frac{Q}{|A_0|\omega_0 C_1} \qquad R_2 = \frac{1}{Q(C_1 + C_2)\omega_0 - \frac{1}{R_1}}$$

$$R_3 = \frac{Q}{\omega_0}\left(\frac{1}{C_1} + \frac{1}{C_2}\right)$$

Example

f_0 = 5000 [Hz]

A_0 = 80

Q = 1200

C_1 = 0.001 [μF]

C_2 = 0.005 [μF]

Step	Data input operation	Read-out	Step	Data input operation	Read-out
	MODE 1	0.	7	EXE	ANS R2(Ohm) 4.421011577
1	PO	f0 0.	8	EXE	ANS R3(Ohm) 45836623.61
2	5000 EXE	A0 5000.	9		.
3	80 EXE	Q 80.	10		
4	1200 EXE	C1 1200.	11		
5	0.001 EXE	C2 1.-09	12		
6	0.005 EXE	ANS R1(Ohm) 477464.8293	13		

Remarks

Program for

Design of an active band-pass filter

	Program	Remark	Step	Contents in memories	
	MODE 3 2nd F MAC MODE 2			00	For Rn display
1	P0			01	$\omega_0 = 2\pi f_0$
2	LBL 1 | "AL | f | O | AL" | HLT | Min 01 |		7	02	A_0
3	"AL | CAPS A | O | AL" | HLT | Min 02 |		13	03	Q
4	"AL | Q | AL" | HLT | Min 03 |	Data input	18	04	C_1
5	"AL | C | 1 | AL" | HLT | EXP | 6 | +/- | Min 04 |		27	05	C_2
6	"AL | C | 2 | AL" | HLT | EXP | 6 | +/- | Min 05 |		36	06	R_1
7	MR 01 | × | 2 | × | SHIFT π | = | Min 01 |	$2\pi f_0$	43	07	
8	MR 02 | ÷ | 2 | = | SHIFT √ | Min F |		49	08	
9	MR 03 | SHIFT x≷F | GOTO 2 | GOTO 3 |		53	09	
10	LBL 2 | 1 | Min 00 | GSB P1 | MR 03 | ÷ | MR 02 | ÷ | MR 01 |	R_1	62	F	
11	÷ | MR 04 | = | Min 06 | HLT |		67	10	
12	GSB P1 | MR 03 | × | MR 01 | × | (| MR 04 | + | MR 05 |) |	R_2	77	11	
13	− | MR 06 | SHIFT 1/x | = | SHIFT 1/x | HLT |		83	12	
14	GSB P1 | MR 03 | ÷ | MR 01 | × | (| MR 04 | SHIFT 1/x | + |	R_3	92	13	
15	MR 05 | SHIFT 1/x |) | = | HLT | GOTO 1 |		98	14	
16	LBL 3 | "AL | T | CAPS r | y | α-s SPACE | a | g | a |		107	15	
17	i | n | α-s ! | AL" |		111	16	
18				17	
19	P1 "AL | CAPS A | N | S | α-s SPACE | R | α-s AR 00 | α-s (| O |		9	18	
20	CAPS h | m | α-s) | AL" | SHIFT ISZ |		14	19	
21				1F	
22		Total 127		20	
23				21	
24				22	
25				23	
26				24	
27				25	
28				26	
29				27	
30				28	
31				29	
32				2F	
33					
34					
35					
36					
37					

Note

If $Q < \sqrt{\frac{|A_0|}{2}}$, calculation will not be made and "Try again!" displayed.

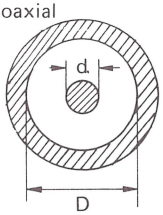
CASIO PROGRAM SHEET

Program for	No.
Impedance of transmission line	Electrical engineering-6

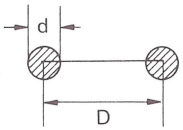
Description

• Input the program written in the next page.

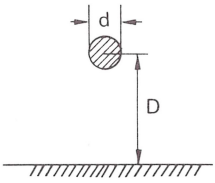
① Coaxial



② Twin-lead



③ Single line



$$Z_1 = \frac{K}{\sqrt{\varepsilon\gamma}} \log \frac{D}{d}$$

$$Z_2 = \frac{2K}{\sqrt{\varepsilon\gamma}} \log \left(\frac{D}{d} + \sqrt{(\frac{D}{d})^2 - 1} \right)$$

$$Z_3 = \frac{K}{\sqrt{\varepsilon\gamma}} \log \left(\frac{4D}{d} \right)$$

$$K = \frac{\sqrt{\mu_0}}{2\pi \sqrt{\varepsilon_0 \log e}} = 138.059824$$

$\varepsilon\gamma$: Dielectric constant

Example 1

D = 20mm
d = 10mm
$\varepsilon\gamma$ = 1.7

Example 2

D = 40mm
d = 5mm
$\varepsilon\gamma$ = 1

Example 3

D = 50mm
d = 7mm
$\varepsilon\gamma$ = 1.35

Step	Data input operation	Read-out	Step	Data input operation	Read-out
	MODE 1	0.	7	5 EXE	Er ? 5.
1	<Ex.1> P1	D(mm) ? 0.	8	1 EXE	ANS Z2(Ohm) 332.0099903
2	20 EXE	d(mm) ? 20.	9	<Ex.3> AC P3	D(mm) ? 0.
3	10 EXE	Er ? 10.	10	50 EXE	d(mm) ? 50.
4	1.7 EXE	ANS Z1(Ohm) 31.87517862	11	7 EXE	Er ? 7.
5	<Ex.2> AC P2	D(mm) ? 0.	12	1.35 EXE	ANS Z3(Ohm) 172.9981701
6	40 EXE	d(mm) ? 40.	13		

Remarks

Step 1 displays coaxial; Step 5 displays flat twin-lead; Step 9 displays single line.

Program for

Impedance of transmission line

	Program	Remark	Step
	MODE 3 2ndF MAC MODE 2		
1	P0 "AL CAPS D (CAPS m m α-s) α-s SPACE α-s ?		8
2	"AL HLT Min 01		11
3	"AL d α-s (m m α-s) α-s SPACE		18
4	α-s ? "AL" HLT Min 02		22
5	"AL EXP r α-s SPACE α-s ? "AL"	Data input	28
6	HLT SHIFT √ Min 03		31
7	MR 01 ÷ MR 02 = Min 05		36
8	1 3 8 • 0 5 9 8 2 4 Min 04		47
9			
10	P1	Coaxial	
11	LBL 1 GSB P0 1 GSB P4		4
12	MR 05 log × MR 04 ÷ MR 03 = HLT GOTO 1		13
13			
14	P2	Twin-lead	
15	LBL 1 GSB P0 2 GSB P4		4
16	MR 05 SHIFT x^2 − 1 = SHIFT √ + MR 05 =		13
17	log × 2 × MR 04 ÷ MR 03 = HLT GOTO 1		23
18			
19	P3	Single line	
20	LBL 1 GSB P0 3 GSB P4		4
21	MR 05 × 4 = log × MR 04 ÷ MR 03 =		14
22	HLT GOTO 1		16
23			
24	P4		
25	Min 00 "AL CAPS A N S α-s SPACE Z α-s AR 00 α-s (		9
26	O CAPS h m α-s) AL"		14
27			
28		Total 118	
29			
30			
31			
32			
33			
34			
35			
36			
37			

	Contents in memories
00	For Zn(Ohm)display
01	D
02	d
03	$\sqrt{\varepsilon_r}$
04	K
05	$\frac{D}{d}$
06	
07	
08	
09	
F	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
1F	
20	
21	
22	
23	
24	
25	
26	
27	
28	
29	
2F	

Note

- D and d should be given in the same unit (such as mm, cm, or inches).
- For Twin-lead, input so that $D \geqq d$.
- For Coaxial, if $D < d$, the answer will be negative.

CASIO PROGRAM SHEET

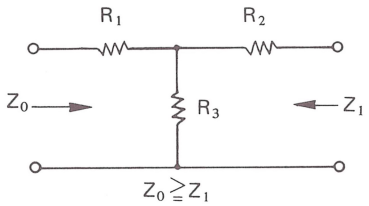
Program for	No.
T-and π-attenuators	Electrical engineering–7

Description

• Input the program written in the next page.

We design attenuators which match line impedances on each end and divide watt to 1/N.

① T-type ---------- P1



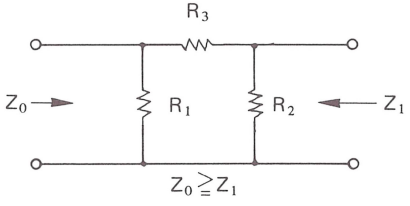
$Z_0 \geqq Z_1$

$$R_1 = Z_0\left(\frac{N+1}{N-1}\right) - R_3$$

$$R_2 = Z_1\left(\frac{N+1}{N-1}\right) - R_3$$

$$R_3 = \frac{2}{N-1}\sqrt{NZ_0Z_1}$$

② π-type ---------- P2



$Z_0 \geqq Z_1$

$$\frac{1}{R_1} = \frac{1}{Z_0}\left(\frac{N+1}{N-1}\right) - \frac{1}{R_3}$$

$$\frac{1}{R_2} = \frac{1}{Z_1}\left(\frac{N+1}{N-1}\right) - \frac{1}{R_3}$$

$$\frac{1}{R_3} = \frac{2}{N-1}\sqrt{\frac{N}{Z_0Z_1}}$$

Example 1

$Z_0 = 200$
$Z_1 = 100$
$N = 50$

Example 2

$Z_0 = 100$
$Z_1 = 50$
$N = 100$

Step	Data input operation	Read-out	Step	Data input operation	Read-out
	MODE 1	0.	9		Z0 ?
1	<Ex.1> P1	T type 0.	10	100 EXE	Z1 ? 100.
2		Z0 ? 0.	11	50 EXE	N ? 50.
3	200 EXE	Z1 ? 200.	12	100 EXE	ANS R1(Ohm) 136.2466105
4	100 EXE	N ? 100.	13	EXE	ANS R2(Ohm) 56.98965817
5	50 EXE	ANS R1(Ohm) 167.3469388	14	EXE	ANS R3(Ohm) 350.0178567
6	EXE	ANS R2(Ohm) 63.26530612	15		
7	EXE	ANS R3(Ohm) 40.81632653	16		
8	<Ex.2> AC P2	π type 0.	17		

Remarks

Program for

T-and π-attenuators

	Program	Remark	Step
	MODE 3 2ndF MAC MODE 2		
1	P0 "AL ; α-s SPACE t y p e		7
2	AL"; SHIFT PAUSE		9
3	"AL CAPS Z O α-s SPACE α-s ? AL" HLT Min 01	Data input	17
4	"AL Z 1 α-s SPACE α-s ? AL" HLT Min 02		25
5	"AL N α-s SPACE α-s ? AL" HLT Min 03		32
6	1 Min 00		34
7			
8	P1	T-type	
9	LBL 1 "AL T AL" GSB P0 GSB P3 GSB P4 HLT		8
10	GSB P4 HLT		10
11	GSB SHIFT P5 MR 04 HLT GOTO 1		14
12			
13	P2	π-type	
14	LBL 1 "AL α-s π AL" GSB P0 MR 01 SHIFT $1/x$ Min 01		8
15	MR 02 SHIFT $1/x$ Min 02 GSB P3 GSB P4 SHIFT $1/x$ HLT		15
16	GSB P4 SHIFT $1/x$ HLT		18
17	GSB SHIFT P5 MR 04 SHIFT $1/x$ HLT GOTO 1		23
18			
19	P3 MR 03 × MR 01 × MR 02 = SHIFT $\sqrt{}$		7
20	× 2 ÷ (MR 03 − 1) Min 05 = Min 04		18
21	(MR 03 + 1) ÷ MR 05 = Min 05		27
22			
23	P4 GSB SHIFT P5		1
24	SHIFT IND MR 00 × MR 05 − MR 04 = SHIFT ISZ		9
25			
26	SHIFT P5 "AL A N S α-s SPACE R α-s AR 00 α-s (O		9
27	CAPS h m α-s) AL"		13
28			
29		Total 126	
30			
31			
32			
33			
34			
35			
36			
37			

	Contents in memories
00	For IND
01	Z_0 or $\frac{1}{Z_0}$
02	Z_1 or $\frac{1}{Z_1}$
03	N
04	R_3 or $\frac{1}{R_3}$
05	N+1/N−1
06	
07	
08	
09	
F	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
1F	
20	
21	
22	
23	
24	
25	
26	
27	
28	
29	
2F	

Note

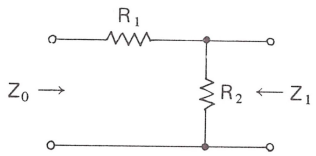
- Input so that $Z_0 \geqq Z_1$.
- N must be a positive number other than N = 1.

CASIO PROGRAM SHEET

Program for	No.
Minimum loss matching	Electrical engineering–8

Description

• Input the program written in the next page.



We calculate R_1 and R_2 which match Z_0 and Z_1 with loss minimized.

$[Z_0 > Z_1]$

$$R_1 = Z_0 \sqrt{1 - \frac{Z_1}{Z_0}}$$

$$R_2 = \frac{Z_1}{\sqrt{1 - \frac{Z_1}{Z_0}}}$$

$$\text{Minimum loss } L_{MIN} = 20 \log \left(\sqrt{\frac{Z_0}{Z_1}} + \sqrt{\frac{Z_0}{Z_1} - 1} \right) \text{ [dB]}$$

Example

Calculate the values of R_1, R_2 and L_{MIN} for Z_0 = 500 ohms and Z_1 = 200 ohms.

Step	Data input operation	Read-out	Step	Data input operation	Read-out
	MODE 1	0.	7		
1	PO	INPUT Z0 ? 0.	8		
2	500 EXE	INPUT Z1 ? 500.	9		
3	200 EXE	ANS R1(Ohm) 387.2983346	10		
4	EXE	ANS R2(Ohm) 258.1988897	11		
5	EXE	Lmin(dB) 8.961393328	12		
6			13		

Remarks

Program for

Minimum loss matching

	Program	Remark	Step
	MODE 3 2ndF MAC MODE 2		
1	P0		
2	LBL 1 | AC | Min 00 |		3
3	GSB P1 | GSB P1 | ÷ | MR 01 | = | Min 03 |		9
4	1 | − | MR 03 | = | SHIFT √ | Min 04 |		15
5	1 | Min 00 |		17
6	GSB P2 | MR 04 | × | MR 01 | = | HLT |	R_1	23
7	GSB P2 | MR 02 | ÷ | MR 04 | = | HLT |	R_2	29
8	"AL | CAPS L | CAPS m | i | n | α-s (| d | CAPS B |		37
9	α-s) | AL" |		39
10	MR 03 | SHIFT 1/x | − | 1 | = | SHIFT √ |		45
11	+ | MR 03 | SHIFT 1/x | SHIFT √ | = | log |		51
12	× | 2 | 0 | = | HLT | GOTO 1 |	L_{MIN}	57
13			
14	P1 "AL | I | N | P | U | T | α-s SPACE | Z | α-s AR 00 | α-s SPACE |	Data input	10
15	α-s ? | AL" | HLT | SHIFT ISZ | SHIFT IND | Min 00 |		16
16			
17	P2 "AL | A | N | S | α-s SPACE | R | α-s AR 00 | α-s SPACE | α-s (| O |		9
18	CAPS h | m | α-s) | AL" | SHIFT ISZ |		14
19			
20		Total 90	
21			
22			
23			
24			
25			
26			
27			
28			
29			
30			
31			
32			
33			
34			
35			
36			
37			

	Contents in memories
00	For IND
01	Z_0
02	Z_1
03	Z_1 / Z_0
04	$\sqrt{1-Z_1/Z_0}$
05	
06	
07	
08	
09	
F	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
1F	
20	
21	
22	
23	
24	
25	
26	
27	
28	
29	
2F	

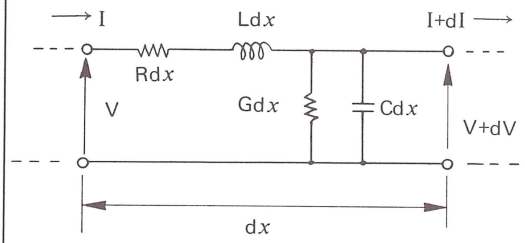
Note

Input so that $Z_0 > Z_1$

Program for	No.
Distributed constant circuit	Electrical engineering–9

Description

• Input the program written in the next page.



Secondary constants

R: Resistance per unit length between two conductors [Ω/km]

L: Inductance per unit length between two conductors [mH/km]

G: Leakage conductance per unit length between two conductors [μ℧/km]

C: Capacitance per unit length between two conductors [μF/km]

Characteristic impedance Z_0

$$Z_0 = \sqrt{\frac{R + j\omega L}{G + j\omega C}}$$

$$|Z_0| = \left(\frac{\sqrt{R^2+\omega^2L^2}}{\sqrt{G^2+\omega^2C^2}}\right)^{\frac{1}{2}} [\Omega]$$

$$\phi = \phi_1 - \phi_2 \quad [\circ]$$

$$\phi_1 = \tan^{-1}\frac{\omega L}{R}$$

$$\phi_2 = \tan^{-1}\frac{\omega C}{G}$$

Propagation constant γ

$$\gamma = \alpha + j\beta$$

Attenuation constant α

$$\alpha = \left(\sqrt{R^2+\omega^2L^2}\cdot\sqrt{G^2+\omega^2C^2}\right)^{\frac{1}{2}}\cos\left(\frac{\phi_1+\phi_2}{2}\right)$$

[Np/km]

Phase constant β

$$\beta = \left(\sqrt{R^2+\omega^2L^2}\cdot\sqrt{G^2+\omega^2C^2}\right)^{\frac{1}{2}}\sin\left(\frac{\phi_1+\phi_2}{2}\right)$$

[rad/km]

Example

R = 167 [Ω/km]

L = 0.49 [mH/km]

G = 1.66 [μ℧/km]

C = 0.05 [μF/km]

f = 1000 [Hz] or 60 [Hz]

Step	Data input operation	Read-out	Step	Data input operation	Read-out
	MODE 1	0.	7	1000 EXE	Z0(Ohm) 729.150475
1	PO	INPUT ! 0.	8	EXE	Phase −44.32054367
2		R(Ohm/km) 0.	9	EXE	Alpha 0.160910291
3	167 EXE	L(mH/km) 167.	10	EXE	Beta 0.163040249
4	0.49 EXE	G(μMho/km) 4.9 −04	11		
5	1.66 EXE	C(μF/km) 1.66 −06	12		
6	0.05 EXE	f(Hz) 5. −08	13		

Remarks

Step 8 displays (Ohm) (Z_0); Step 9 displays Phase (ϕ); Step 10 displays Alpha (α); Step 11 displays Beta (β).

Program for

Distributed constant circuit

	Program	Remark	Step
	MODE 3 2nd MAC MODE 2		
1	POGSBP3 "AL CAPS R α-s (O CAPS h m α-s /		8
2	k m α-s) AL" HLT Min01		14
3	"AL CAPS L α-s (CAPS m CAPS H α-s / CAPS k m		22
4	α-s) AL" HLT EXP 3 +/- Min02		29
5	"AL CAPS G α-s (α-s μ M CAPS h O α-s /	Data input	37
6	k m α-s) AL" HLT ÷ 6 SHIFT 10^x =		46
7	Min03		47
8	"AL CAPS C α-s (α-s μ F α-s / CAPS k m		55
9	α-s) AL" HLT EXP 6 +/- Min04 MODE 4		63
10	LBL 1 "AL f α-s (CAPS H CAPS Z α-s) AL" HLT		72
11	× 2 × SHIFT π = Min05	$2\pi f$	78
12	MR01 SHIFT x^2 + MR05 SHIFT x^2 × MR02	$\sqrt{R^2+\omega^2L^2}$	85
13	SHIFT x^2 = SHIFT $\sqrt{\ }$ Min06		89
14	MR03 SHIFT x^2 + MR05 SHIFT x^2 × MR04	$\sqrt{G^2+\omega^2C^2}$	96
15	SHIFT x^2 = SHIFT $\sqrt{\ }$ Min07		100
16	MR05 × MR02 ÷ MR01 = SHIFT $\tan^{-1}$	ϕ_1	107
17	Min08		108
18	MR03 SHIFT x=0 GOTO 2 GOTO 3	G=0 ?	112
19	LBL 2 9 0 Min09 GOTO 4		117
20	LBL 3 MR05 × MR04 ÷ MR03 = SHIFT $\tan^{-1}$	ϕ_2	125
21	Min09		126
22	LBL 4 "AL Z 0 α-s (O CAPS h m α-s) AL"	Z	136
23	MR06 ÷ MR07 = SHIFT $\sqrt{\ }$ HLT		142
24	"AL CAPS P CAPS h a s e AL"	ϕ	149
25	(MR08 − MR09) ÷ 2 = HLT		158
26	"AL CAPS A CAPS I p h a AL"	α	165
27	GSB P1 cos GSB P2 HLT		169
28	"AL CAPS B CAPS e t a AL"	β	175
29	GSB P1 sin GSB P2 HLT		179
30	GSB P3 GOTO 1		181
31			
32	P1 (MR08 + MR09) ÷ 2 =		8
33			
34	P2 × (MR06 × MR07) SHIFT $\sqrt{\ }$ =		8
35			
36	P3 "AL CAPS I N P U T α-s SPACE α-s / AL" SHIFT PAUSE		10
37		Total 211	

	Contents in memories
00	
01	R
02	L
03	G
04	C
05	$\omega=2\pi f$
06	$\sqrt{R^2+\omega^2L^2}$
07	$\sqrt{G^2+\omega^2C^2}$
08	ϕ_1
09	ϕ_2
F	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
1F	
20	
21	
22	
23	
24	
25	
26	
27	
28	
29	
2F	

Note

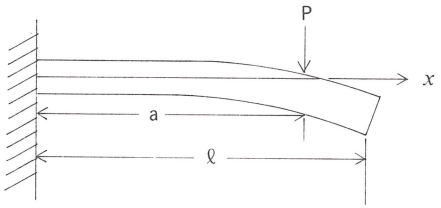
- Input frequency in the unit of Hz.
- Input R, L, G, C and f, $|Z_0|$, ϕ, α and β will be displayed. Repeat this procedure if necessary.
- Leakage conductance G may be neglected (Input 0).

CASIO PROGRAM SHEET

Program for	No.
Cantilever under concentrated load	Mechanics-1

Description

• Input the program written in the next page.



E : Young's modulus [kg/mm^2]

I : Geometrical moment of inertia [mm^4]

a : Distance of concentrated load from support [mm]

P : Load [kg]

Deflection y [mm], Angle of deflection S [°], Bending moment M [kg·mm]

① $\ell > x > a$

$$y = \frac{Pa^3}{6EI} - \frac{Pa^2}{2EI}x$$

$$S = \tan^{-1}\left[-\frac{Pa^2}{2EI}\right]$$

M = 0 (shearing load Ws = 0)

② $x \leqq a$

$$y = \frac{P}{6EI}x^3 - \frac{Pa}{2EI}x^2$$

$$S = \tan^{-1}\left\{\frac{Px}{2EI}(x - 2a)\right\}$$

M = P (x − a)

(shearing load Ws = P)

Example

E = 4,000 (kg/mm^2)

I = 5 (mm^4)

a = 30 (mm)

P = 2 (kg)

What are deflection, angle of deflection, bending moment and shearing load at x = 25mm and x = 32mm ?

Step	Data input operation	Read-out	Step	Data input operation	Read-out
	MODE 1	0.	7	EXE	s = −2.505092867
1	PO	0.	8	EXE	M= −10.
2	(E) 4000 EXE	4000.	9	(x) 32 EXE	y = −0.99
3	(I) 5 EXE	5.	10	EXE	s = −2.57657183
4	(a) 30 EXE	30.	11	EXE	M= 0.
5	(P) 2 EXE	0.	12		
6	(x) 25 EXE	y = −0.677083333	13		

Remarks

Program for

Cantilever under concentrated load

	Program	Remark	Step
	MODE 3 2ndF MAC MODE 2		
1	P0 HLT Min 01 HLT Min 02 HLT Min03 Min F HLT Min 04		9
2	÷ 2 ÷ MR 01 ÷ MR 02 = Min06 ÷ 3 =		20
3	Min 07 0 MODE 4		23
4	LBL 1 HLT Min 05 SHIFT $x \geq t$ GOTO 2 GOTO 3		29
5	LBL 2 MR 07 × MR 03 SHIFT x^y 3 − MR 06 × MR 03		39
6	SHIFT x^2 × MR 05 GSB P1		43
7	MR 06 × MR 03 SHIFT x^2 = ±/− GSB P2		50
8	0 GSB P3 GOTO 1		53
9	LBL 3 MR 07 × MR 05 SHIFT x^y 3 − MR 06 × MR 03		63
10	× MR 05 SHIFT x^2 = GSB P1		68
11	MR 06 × MR05 × (MR 05 − 2 × MR 03)		79
12	= GSB P2		81
13	MR 04 × (MR05 − MR03) GSB P3 GOTO 1		90
14			
15	P1 "AL y = AL" = HLT		6
16			
17	P2 "AL S = AL" SHIFT $\tan^{-1}$ HLT		6
18			
19	P3 "AL CAPS M = AL" = HLT		6
20			
21		Total 112	
22			
23			
24			
25			
26			
27			
28			
29			
30			
31			
32			
33			
34			
35			
36			
37			

Contents in memories	
00	
01	E
02	I
03	a
04	p
05	x
06	P/2EI
07	P/6EI
08	
09	
F	a
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
1F	
20	
21	
22	
23	
24	
25	
26	
27	
28	
29	
2F	

Note

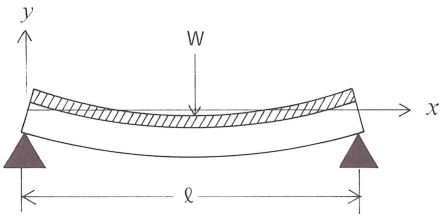
Following E, I, a and P, input x ($< \ell$, in mm) which the distance between the support and a point of interest. Then the values of y, S and M will be displayed. Input other values of x as necessary.

CASIO PROGRAM SHEET

Program for	No.	
Simple beam under distributed load	Mechanics-2	

Description

• Input the program written in the next page.



E : Young's modulus [kg/mm^2]

I : Geometrical moment of intertia [mm^4]

ℓ : Overall length of beam [mm]

W : Distributed load [kg/mm]

Deflection $y = -\frac{Wx}{24EI}\left\{\ell^3 + x^2(x - 2\ell)\right\}$ [mm]

Angle of deflection $S = \tan^{-1}\left[-\frac{W}{24EI}\left\{\ell^3 + x^2(4x - 6\ell)\right\}\right]$ [°]

Bending moment $M = -\frac{Wx}{2}(x - \ell)$ [kg·mm]

Shearing load $Ws = W\left(\frac{\ell}{2} - x\right)$ [kg]

Example

E = 4,000 (kg/mm^2)

I = 5 (mm^4)

ℓ = 40 (mm)

W = 0.05 (kg/mm)

What are deflection, angle of deflection, bending moment and shearing load at x = 10 mm and x = 25 mm ?

Step	Data input operation	Read-out	Step	Data input operation	Read-out
	MODE 1	0.	7	EXE	S = −0.262603817
1	PO	0.	8	EXE	M= 7.5
2	(E) 4000 EXE	4000.	9	EXE	Ws = 0.5
3	(I) 5 EXE	5.	10	25 EXE	y = −0.077148437
4	(ℓ) 40 EXE	40.	11	EXE	S = 0.140255013
5	(W) 0.05 EXE	0.05.	12	EXE	M= 9.375
6	(x) 10 EXE	y = −0.059375	13	EXE	Ws = −0.25

Remarks

Program for

Simple beam under distributed load

	Program	Remark	Step
	MODE 3 2ndF MAC MODE 2		
1	P0 HLT Min 01 HLT Min 02 HLT Min 03 HLT Min 04 MODE 4		9
2	LBL 1 HLT Min 05 MR 04 ÷ 2 4 ÷ MR 01 ÷ MR 02 =		21
3	+/− Min 06		23
4	MR 03 SHIFT x^y 3 = Min 07		28
5	MR 05 × GSB P1 − 2 × MR 03)) "AL		38
6	Y = "AL" = HLT		43
7	GSB P1 × 4 − 6 × MR 03)) = "AL		54
8	S = "AL" SHIFT $\tan^{-1}$ HLT		59
9	MR 04 × MR 05 ÷ 2 × (MR 05 − MR 03)		70
10	"AL CAPS M = "AL" = +/− HLT		77
11	MR 04 × (MR 03 ÷ 2 − MR 05)		86
12	"AL W CAPS S = "AL" = GOTO 1		93
13			
14	P1 MR 06 × (MR 07 + MR 05 SHIFT x^2 × (MR 05		10
15			
16		Total 105	
17			
18			
19			
20			
21			
22			
23			
24			
25			
26			
27			
28			
29			
30			
31			
32			
33			
34			
35			
36			
37			

	Contents in memories
00	
01	E
02	I
03	l
04	W
05	x
06	$-W/24EI$
07	l^3
08	
09	
F	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
1F	
20	
21	
22	
23	
24	
25	
26	
27	
28	
29	
2F	

Note

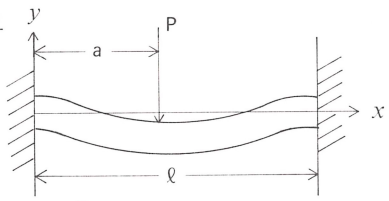
Enter MODE 4 and specify DEG.

Repeat display of y, s, M, and Ws can be obtained following input of E, I, ℓ, and W, by inputting any bend position x (mm) in the range of $x < \ell$.

CASIO PROGRAM SHEET

Program for	Beam fixed at both ends under concentrated load	No.	Mechanics-3	

Description



• Input the program written in the next page.

E : Young's modulus [kg/mm^2]

I : Geometrical moment of inertia [mm^4]

a : Distance of concentrated load from a support [mm]

P : Concentrated load [kg]

① $x \leqq a$

Deflection $y = \dfrac{P(\ell - a)^2 x^2}{6EI\ell^3} \left\{ x(\ell + 2a) - 3a\ell \right\}$ [mm]

Angle of deflection $S = \tan^{-1} \left[\dfrac{P(\ell - a)^2 x}{2EI\ell^3} \left\{ x(\ell + 2a) - 2a\ell \right\} \right]$ [°]

Bending moment $M = \dfrac{P(\ell - a)^2}{\ell^3} \left\{ x(\ell + 2a) - a\ell \right\}$ [kg·mm]

Shearing load $Ws = \dfrac{P(\ell - a)^2}{\ell^3} (\ell + 2a)$ [kg]

② $a < x < \ell$

Replace a with $(\ell - a)$ and x with $(\ell - x)$ in the above equations.

Example

E = 4,000 (kg/mm^2) a = 10 (mm)

I = 5 (mm^4) P = 5 (kg)

ℓ = 40 (mm)

What are deflection, angle of deflection, bending moment and shearing load at x = 20mm and x = 5mm ?

Step	Data input operation	Read-out	Step	Data input operation	Read-out
	MODE 1	0.	8	EXE	−0.089524582
1	PO	0.	9	EXE	6.25
2	(E) 4000 EXE	4000.	10	EXE	0.78125
3	(I) 5 EXE	0.	11	(x) 5 EXE	−0.013183595
4	(ℓ) 40 EXE	40.	12	EXE	−0.251786472
5	(a) 10 EXE	10.	13	EXE	−7.03125
6	(P) 5 EXE	0.	14	EXE	4.21875
7	(x) 20 EXE	−0.041666666	15		

Remarks

Steps 7 and 11 display (y); Steps 8 and 12 display (S); Steps 9 and 13 display (M); Steps 10 and 14 display (Ws).

Program for
Beam fixed at both ends under concentrated load

	Program	Remark	Step
	MODE 3 2ndF MAC MODE 2		
1	P0 HLT ×HLT =Min01 0 HLT Min02 HLT Min F HLT		11
2	÷MR 02 SHIFT x^y 3 =Min03 0 MODE 4		19
3	LBL 1 HLT Min04 SHIFT $x \geq$ F GOTO 2 MR F Min08 MR 04 Min09		28
4	GSB P1 GOTO 1		30
5	LBL 2 MR 02 − MR F =Min08 MR 02 − MR 04 =		40
6	Min09 GSB P1 GOTO 1		43
7			
8	P1 MR 09 × (MR 02 + 2 × MR 08) =Min04		11
9	MR 02 × MR 08 =Min05 MR 03 × (MR 02 −		21
10	MR 08) SHIFT x^2 =Min06 ÷ 2 ÷ MR 01 ×		31
11	MR 09 =Min07 ÷ 3 × MR 09		38
12	GSB P2 3 × GSB P3 HLT		43
13	MR 07 GSB P2 2 × GSB P3 SHIFT $\tan^{-1}$ HLT		50
14	MR 06 GSB P2 GSB P3 HLT		54
15	MR 06 × MR 04 ÷ MR 09 =		60
16			
17	P2 × (MR 04 −		4
18			
19	P3 MR 05) =		3
20			
21		Total 114	
22			
23			
24			
25			
26			
27			
28			
29			
30			
31			
32			
33			
34			
35			
36			
37			

	Contents in memories
00	
01	$E \times I$
02	l
03	P / l^3
04	
05	al or $l(l-a)$
06	$\frac{P(l-a)^2}{l^3}$ or $\frac{Pa^2}{l^3}$
07	$\frac{P(l-a)^2x}{2EIl^3}$ or $\frac{Pa^2(l-x)}{2EIl^3}$
08	a or $l-a$
09	x or $l-x$
F	a
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
1F	
20	
21	
22	
23	
24	
25	
26	
27	
28	
29	
2F	

Note

Enter MODE 4 and specify DEG.

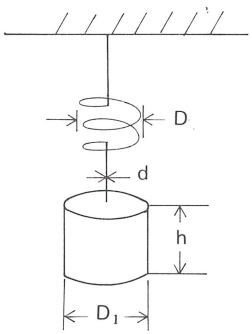
Repeat display of y, s, and M, can be obtained following input of E, I, ℓ, a, and P, by inputting any bend position x (mm) in the range of $x < \ell$.

CASIO PROGRAM SHEET

Program for	No.	
Free vibration	Mechanics-4	

Description

• Input the program written in the next page.



Weight of load $W = \frac{\pi}{4} D_1^2 hb$

Mass of load $m = \frac{W}{980}$

Spring constant $K = \frac{Gd^4}{8ND^3}$

Natural vibration frequency

$$f = \frac{1}{2\pi}\sqrt{\frac{K}{m}}$$

d, D, D_1, h (cm) b (kg/cm^3)

N : Number of effective coils

G : Shearing modulus (kg/cm^2)

Example

d = 0.5 (cm)
D = 4 (cm)
N = 10
G = 750,000 (kg/cm^2)
D_1 = 25 (cm)
h = 7 (cm)
b = 0.0077 (kg/cm^3)

What is the natural frequency (f) ?
If d is 0.4 and N is 20 with the other data unchanged, what become f ?

Step	Data input operation	Read-out	Step	Data input operation	Read-out
	MODE 1	0.	10	25 EXE	h = 25.
1	P1	d = ? 0.	11	7 EXE	b = 7.
2	0.5 EXE	0.5	12	0.0077 EXE	7.7^{-03}
3	P2	D = ? 0.5	13	P0	f = 2.930822368
4	4 EXE	4.	14	P1	d = ? 2.930822368
5	P3	N = ? 4.	15	0.4 EXE	0.4
6	10 EXE	10.	16	P3	N = 0.4
7	P4	G = ? 10.	17	20 EXP	20.
8	750000 EXE	75000.	18	P0	f = 1.326338797
9	SHIFT P5	D1 75000.	19		

Remarks

Program for

Free vibration

	Program	Remark	Step	Contents in memories	
	MODE 3 2ndF MAC MODE 2			00	
1	P1 "AL| d | = | α-s ? | AL" | HLT | Min 01 |		7	01	d
2				02	D
3	P2 "AL | CAPS D | = | α-s ? | AL" | HLT | Min 02 |		7	03	N
4				04	G
5	P3 "AL | N | = | α-s ? | AL" | HLT | Min 03 |		7	05	D1
6				06	h
7	P4 "AL | G | = | α-s ? | AL" | HLT | Min 04 |		7	07	b
8				08	K
9	SHIFT P5 "AL | D | 1 | = | α-s ? | AL" | HLT | Min 05 |		8	09	m
10	"AL | CAPS h | = | α-s ? | AL" | HLT | Min 06 |		15	F	
11	"AL | b | = | α-s ? | AL" | HLT | Min 07 |		22	10	
12				11	
13	P0 MR 04 | × | MR 01 | SHIFT x^y | 4 | ÷ | 8 | ÷ | MR 03 | ÷ |		10	12	
14	MR 02 | SHIFT x^y | 3 | = | Min 08 |		15	13	
15	SHIFT π | × | MR 05 | SHIFT x^2 | × | MR 06 | × | MR 07 | ÷ | 4 | ÷ |		26	14	
16	9 | 8 | 0 | = | Min 09 |		31	15	
17	MR 08 | ÷ | MR 09 | = | SHIFT $\sqrt{\ }$ | ÷ | 2 | ÷ | SHIFT π |		40	16	
18	"AL | f | = | AL" | = |		45	17	
19				18	
20		Total 101		19	
21				1F	
22				20	
23				21	
24				22	
25				23	
26				24	
27				25	
28				26	
29				27	
30				28	
31				29	
32				2F	
33					
34					
35					
36					
37					

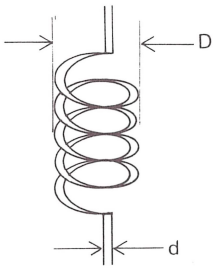
Note

CASIO PROGRAM SHEET

Program for	No.	
Design of coil spring	Mechanics-5	

Description

• Input the program written in the next page.



d : Wire diameter [mm]
D : Mean coil diameter [mm]
Na: Number of effective coils
G : Shearing modulus [kg/mm^2]
y : Deflection [mm]
P : Load [kg]
K : Spring constant [kg/mm]

$$P = Ky = \frac{Gd^4}{8NaD^3}\, y$$

① Input d ⟶ P1
② Input D ⟶ P2
③ Input Na ⟶ P3
④ Input G ⟶ P4
⑤ Input y ⟶ P5
⑥ Input P ⟶ P6

① Calculate K and P ⟶ P0
② Calculate d ⟶ P7
③ Calculate D ⟶ P8
④ Calculate Na ⟶ P9

Example

1. d = 0.5 (mm)
   D = 5 (mm)
   Na = 10
   G = 4,000 (kg/mm^2)
   y = 10 (mm)
   What are K and P ?

2. D = 5 (mm)
   Na = 10
   G = 4,000 (kg/mm^2)
   y = 10 (mm)
   P = 0.25 (kg)
   What is d ?

Step	Data input operation	Read-out	Step	Data input operation	Read-out
	MODE 1	0.	7	EXE	P= 0.25
1	⟨Ex.1⟩ (d) 0.5 P1	0.5	8	⟨Ex.2⟩ (P) 0.25 SHIFT P6	P= 0.25
2	(D) 5 P2	5.	9	SHIFT P7	d= 0.5
3	(Na) 10 P3	10.	10		
4	(G) 4000 P4	4000.	11		
5	(y) 10 SHIFT P5	10.	12		
6	P0	K= 0.025	13		

Remarks

Program for

Design of coil spring

	Program	Remark	Step	Contents in memories	
	MODE 3 2ndF MAC MODE 2			00	
1	P1 Min 01 ▷		1	01	d
2				02	D
3	P2 Min02 ▷		1	03	Na
4				04	G
5	P3 Min03 ▷		1	05	y
6				06	P
7	P4 Min05 ▷		1	07	
8				08	
9	SHIFT P5 Min04 ▷		1	09	
10				F	
11	SHIFT P6 Min06 ▷		1	10	
12				11	
13	P0 MR 01 ▷ SHIFT x^y ▷ 4 ▷ × ▷ MR 04 ▷ ÷ ▷ 8 ▷ ÷ ▷ MR 02 ▷		9	12	
14	SHIFT x^y ▷ 3 ▷ ÷ ▷ MR 03 ▷		13	13	
15	"AL ▷ CAPS K ▷ = ▷ AL" ▷ = ▷ HLT ▷		19	14	
16	× ▷ MR 05 ▷		21	15	
17	"AL ▷ P ▷ = ▷ AL" ▷ = ▷ HLT ▷		27	16	
18				17	
19	SHIFT P7 8 ▷ × ▷ MR 02 ▷ SHIFT x^y ▷ 3 ▷ × ▷ MR 03 ▷ × ▷ MR 06 ▷		9	18	
20	÷ ▷ MR 04 ▷ ÷ ▷ MR 05 ▷ = ▷ SHIFT $x^{\frac{1}{y}}$ ▷ 4 ▷		16	19	
21	"AL ▷ CAPS d ▷ = ▷ AL" ▷ = ▷ HLT ▷		22	1F	
22				20	
23	SHIFT P8 MR 01 ▷ SHIFT x^y ▷ 4 ▷ × ▷ MR 04 ▷ × ▷ MR 05 ▷ ÷ ▷ 8 ▷ ÷ ▷		10	21	
24	MR 03 ▷ ÷ ▷ MR 06 ▷ = ▷ SHIFT $x^{\frac{1}{y}}$ ▷ 3 ▷		16	22	
25	"AL ▷ CAPS D ▷ = ▷ AL" ▷ = ▷ HLT ▷		22	23	
26				24	
27	SHIFT P9 MR 01 ▷ SHIFT x^y ▷ 4 ▷ × ▷ MR 04 ▷ × ▷ MR 05 ▷ ÷ ▷ 8 ▷ ÷ ▷		10	25	
28	MR 02 ▷ SHIFT x^y ▷ 3 ▷ ÷ ▷ MR 06 ▷		15	26	
29	"AL ▷ N ▷ CAPS a ▷ = ▷ AL" ▷ = ▷ HLT ▷		22	27	
30				28	
31		Total 109		29	
32				2F	
33					
34					
35					
36					
37					

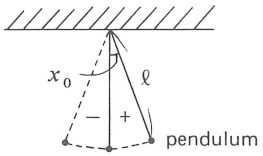
Note

CASIO PROGRAM SHEET

Program for	No.	
Simple pendulum	Physics/chemistry-1	

Description

• Input the program written in the next page.



Period $T = 2\pi\sqrt{\frac{\ell}{g}}$ (sec.)

ℓ: Length of pendulum (cm)

g: 980 (cm/sec.)

$$x = x_0 \times \cos\left(360\,\frac{t}{T}\right)$$

Example

Let ℓ = 100 cm, x_0 = 15° and t (int) = 0.2 sec.

What is the value of x at each time slot.

Step	Data input operation	Read-out	Step	Data input operation	Read-out
	MODE 1	0.	7	EXE	t 2 = 0.4
1	PO	I = ? 0.	8		X 2 = 4.698535053
2	(ℓ) 100 EXE	x 0 = ? 100.	9		Repeat these steps.
3	(x_0) 15 EXE	T = 2.007089923	10		
4	EXE	t (i n t) = ? 2.007089923	11		
5	(t(int)) 0.2 EXE	t 1 = 0.2	12		
6		X 1 = 12.15479382	13		

Remarks

Program for

Simple pendulum

	Program	Remark	Step
	MODE 3 2ndF MAC MODE 2		
1	P0 0 Min 07 "AL I = α-s ? AL" HLT Min 01	Input ℓ	9
2	"AL x_0 0 = α-s ? AL" HLT Min 02	Input x_0	17
3	MR 01 ÷ 9 8 0 = SHIFT $\sqrt{\ }$ × 2 × SHIFT π = Min 03		30
4	"AL CAPS T = AL" MR 03		35
5	HLT	Output T	36
6	"AL CAPS t α-s (i n t α-s) =		44
7	α-s ? AL" HLT Min 04 MODE 4 1 Min 08	Inqut $t(int)$	51
8	LBL 1 "AL t α-s AR 08 = AL"		57
9	MR 04 M+ 07 MR 07 SHIFT PAUSE	Output ti	61
10	"AL x α-s AR 08 = AL"		66
11	MR 02 × ((MR 07 ÷ MR 03)		74
12	SHIFT FRAC × 3 6 0) cos = HLT	Output xi	83
13	1 M+ 08 GOTO 1		86
14			
15		Total 87	
16			
17			
18			
19			
20			
21			
22			
23			
24			
25			
26			
27			
28			
29			
30			
31			
32			
33			
34			
35			
36			
37			

	Contents in memories
00	
01	ℓ
02	x_0
03	T
04	$t\,(int)$
05	
06	
07	ti
08	Subscript i of ti and xi
09	
F	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
1F	
20	
21	
22	
23	
24	
25	
26	
27	
28	
29	
2F	

Note

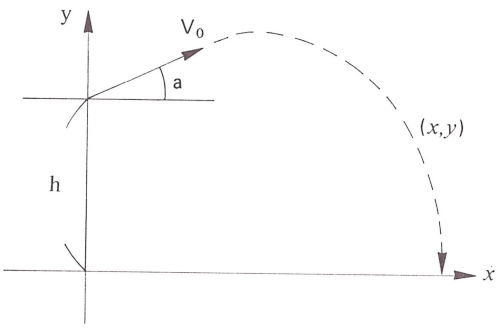
Enter MODE 4 and specify DEG.
When ℓ and x_0 have been input, T is displayed.
After time interval t (int) is input, ti and xi will be displayed repeatedly.

CASIO PROGRAM SHEET

Program for	No.	
Parabolic movement	Physics/chemistry-2	

Description

- Input the program written in the next page.



$x = (V_0 \cos a)t$

$y = (V_0 \sin a)t - \frac{1}{2}gt^2 + h$

$g = 9.8\ [m/s^2]$

$(a=\theta)$

V_0 [m/s]

a [°]

Δt [sec.]

h [m]

Example

Initial velocity V_0 = 130 (m/s)

Initial angle a = 25 (°)

Height h = 0 (m)

Δt = 0.5 (sec.)

Plot the trace of movement in intervals of Δt.

Step	Data input operation	Read-out	Step	Data input operation	Read-out
	MODE 1	0.	7	EXE	y = 26.24518701
1	PO	V0=? 0.	8	EXE	t = 1.
2	130 EXE	a=? 130.	9	EXE	x = 117.8200123
3	25 EXE	h=? 25.	10	EXE	y = 50.04037403
4	0 EXE	dt=? 0.	11		
5	0.5 EXE	t = 0.5	12		
6	EXE	x = 58.91000616	13		

Remarks

Program for

Parabolic movement

	Program	Remark	Step
	MODE 3 2ndF MAC MODE 2		
1	PO MODE 4 ┘		1
2	"AL┘CAPS V┘0┘=┘α-s ?┘AL"┘HLT┘Min 01┘	Input V_0	9
3	"AL┘CAPS a┘=┘α-s ?┘AL"┘HLT┘Min 02┘	Input a	16
4	"AL┘h┘=┘α-s ?┘AL"┘HLT┘Min 03┘	Input h	23
5	"AL┘d┘t┘=┘α-s?┘AL"┘HLT┘Min 04┘		31
6	Min 05┘	Input $\triangle t$	32
7	LBL 1┘"AL┘t┘=┘AL"┘MR 05┘HLT┘	Output t	39
8	"AL┘x┘=┘AL"┘MR 01┘×┘MR 02┘cos┘		47
9	×┘MR 05┘=┘HLT┘	Output x	51
10	"AL┘y┘=┘AL"┘MR 01┘×┘MR 02┘sin┘		59
11	×┘MR 05┘−┘4┘·┘9┘×┘MR 05┘SHIFT x^2┘+┘MR 03┘		70
12	=┘HLT┘	Output y	72
13	MR 04┘M+ 05┘GOTO 1┘		75
14			
15		Total 76	
16			
17			
18			
19			
20			
21			
22			
23			
24			
25			
26			
27			
28			
29			
30			
31			
32			
33			
34			
35			
36			
37			

Contents in memories	
00	
01	V_0
02	a
03	h
04	$\triangle t$
05	Variable
06	
07	
08	
09	
F	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
1F	
20	
21	
22	
23	
24	
25	
26	
27	
28	
29	
2F	

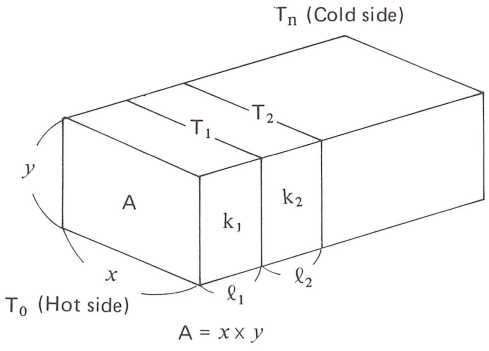
Note

CASIO PROGRAM SHEET

Program for	No.
Thermal conduction through layers	Physics/chemistry–3

Description

• Input the program written in the next page.



$A = x \times y$

Heat loss

$$q = \frac{T_0 - T_n}{\frac{\ell_1}{k_1 A} + \frac{\ell_2}{k_2 A} + \cdots + \frac{\ell n}{KnA}} \quad [K\,cal/h]$$

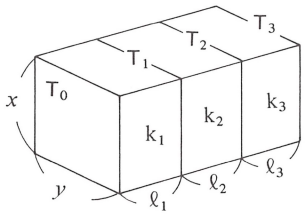
k : Thermal conductivity $[K\,cal/m \cdot h \cdot deg]$

$$T_1 = T_0 - \frac{q\ell_1}{k_1 A}$$

$$T_2 = T_1 - \frac{q\ell_2}{k_2 A}$$

$$T_n = T_{n-1} - \frac{q\ell_n}{k_n A}$$

Example



x = 1 [m] , y = 1 [m] ,

ℓ_1 = 0.25[m] k_1 = 1.2 $[K\,cal/m \cdot h \cdot deg]$

ℓ_2 = 0.12[m] k_2 = 0.25 $[K\,cal/m \cdot h \cdot deg]$

ℓ_3 = 0.15[m] k_3 = 0.75 $[K\,cal/m \cdot h \cdot deg]$

Let T_0 = 900°C and T_3 = 100°C.

Calculate T_1 and T_2.

Step	Data input operation	Read-out	Step	Data input operation	Read-out
	MODE 1	0.	9	0.75 EXE	INPUT I4 3.
1	PO	INPUT x 0.	10	GOTO 1	INPUT T0 3.
2	1 EXE	INPUT y 1.	11	900 EXE	INPUT Tn 900.
3	EXE	INPUT I1 1.	12	100 EXE	q= 900.5628518
4	0.25 EXE	INPUT k1 0.25	13	EXE	T1= 712.3827392
5	1.2 EXE	INPUT I2 5.	14	EXE	T2= 280.1125704
6	0.12 EXE	INPUT k2 0.12	15	EXE	T3= 100.
7	0.25 EXE	INPUT I3 4.	16		Repeat from step 2.
8	0.15 EXE	INPUT k3 0.15	17		

Remarks

Program for

Thermal conduction through layers

	Program	Remark	Step
	MODE 3 2ndF MAC MODE 2		
1	P0		
2	LBL 2 ‖ 2ndF MAC ‖ GSB P1 ‖ "AL" ‖ ; ‖ X ‖ AL" ‖ HLT ‖ Min 01 ‖	Input x	9
3	GSB P1 ‖ "AL" ‖ ; ‖ Y ‖ AL" ‖ HLT ‖ × ‖ MR 01 ‖ = ‖	Input y	18
4	Min 09 ‖	$x \times y = A$	19
5	LBL 3 ‖ SHIFT ISZ ‖		21
6	GSB P1 ‖ "AL" ‖ ; ‖ I ‖ α-s AR 00 ‖ AL" ‖ HLT ‖ Min 07 ‖	Input ℓi	29
7	GSB P1 ‖ "AL" ‖ ; ‖ k ‖ α-s AR 00 ‖ AL" ‖ HLT ‖ Min 08 ‖	Input ki	37
8	MR 07 ‖ ÷ ‖ MR 08 ‖ ÷ ‖ MR 09 ‖ = ‖ SHIFT IND ‖ Min 00 ‖ M+ F ‖		46
9	6 ‖ − ‖ MR 00 ‖ = ‖ SHIFT x=0 ‖ GOTO 1 ‖ GOTO 3 ‖	Input 6th layer ?	53
10	LBL 1 ‖ GSB P1 ‖ "AL" ‖ ; ‖ CAPS T ‖ O ‖ AL" ‖ HLT ‖ Min 07 ‖	Input T_o	62
11	GSB P1 ‖ "AL" ‖ ; ‖ T ‖ CAPS n ‖ AL" ‖ HLT ‖ Min 08 ‖	Input T_n	70
12	"AL" ‖ q ‖ = ‖ AL" ‖ (‖ MR 07 ‖ − ‖ MR 08 ‖		78
13	) ‖ ÷ ‖ MR F ‖ = ‖ Min 09 ‖ HLT ‖	Output q	84
14	MR 00 ‖ = ‖ Min F ‖ 0 ‖ Min 00 ‖	M0 clear	89
15	LBL 4 ‖ SHIFT ISZ ‖ MR 00 ‖ SHIFT x=F ‖ GOTO 2 ‖	n-th layer ?	94
16	"AL ‖ CAPS T ‖ α-s AR 00 ‖ = ‖ AL" ‖ MR 07 ‖ − ‖ MR 09 ‖		102
17	× ‖ SHIFT IND ‖ MR 00 ‖ = ‖ Min 07 ‖ HLT ‖ GOTO 4 ‖	Output Ti	109
18			
19	P1 "AL ‖ I ‖ N ‖ P ‖ U ‖ T ‖ α-s SPACE ‖ AL" ‖		8
20			
21		Total 119	
22			
23			
24			
25			
26			
27			
28			
29			
30			
31			
32			
33			
34			
35			
36			
37			

	Contents in memories
00	Number of layers
01	$x \rightarrow \ell_1 / K_1 A$
02	$\ell_2 / K_2 A$
03	$\ell_3 / K_3 A$
04	$\ell_4 / K_4 A$
05	$\ell_5 / K_5 A$
06	$\ell_6 / K_6 A$
07	$Ki \rightarrow Tn$
08	$\ell i \rightarrow To$
09	$A \rightarrow q$
F	$\Sigma(\ell i / Ki A)$
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
1F	
20	
21	
22	
23	
24	
25	
26	
27	
28	
29	
2F	

Note

Up to six layers are permitted.

Input ℓ and k of each layer. Operate GOTO 1 . And input T_0 and T_n.

If the number of layers is six, GOTO 1 is not necessary. Input T_0 and T_n immediately.

(Six layers are set on the ninth line of the program. By changing this value, input becomes possible up to any arbitrary number of layers.)

CASIO PROGRAM SHEET

Program for	No.	
First- and second-order reaction speeds	Physics/chemistry-4	

Description

• Input the program written in the next page.

(1) First-order reaction → P1

$$K_i = \frac{1}{t_i} \ell_n \frac{a}{mi}$$

$$t^{\frac{1}{2}} = \frac{\ell_n 2}{\overline{K}}$$

$$\overline{K} = \frac{\Sigma K_i}{n}$$

K : Velocity constant

a : Initial concentration

m_i : Concentration after t_i

t_i : Time in minutes

$t^{\frac{1}{2}}$: Half life

(2) Second-order reaction → P2

(A) $a \neq b$

$$K_i = \frac{1}{t_i(a-b)} \ell_n \frac{b(a-x)}{a(b-x)}$$

$$= \frac{1}{t_i(a-b)} \ell_n \frac{bm_i}{a(b-a+m_i)} \quad [^{mol}/_{\ell \cdot t}]$$

(B) $a = b$

$$K_i = \frac{x}{t_i\, a(a-x)} = \frac{a - m_i}{t_i a\, m_i}$$

a, b: Initial concentration

x: Variation of concentration after t_i

Example

Minute	0	10	20	30	50
Current concentration	34.75	28.45	23.35	15.85	13.05

Obtain first-order reaction K_i, n, $\overline{K}$ and $t^{\frac{1}{2}}$ based on the above table.

Step	Data input operation	Read-out	Step	Data input operation	Read-out
	MODE 1	0.	7	20 EXE	K 2 = 0.019879129
1	P1	a ? 0.	8	Input all data	After K4 displayed.
2	34.75 EXE	m 1 34.75	9	EXE	4.
3	28.45 EXE	t 1 28.45	10	EXE	0.021409275
4	10 EXE	K 1 = 0.020003141	11	EXE	32.3760224
5	EXE	m 2 ? -3.	12		
6	23.35 EXE	t 2 ? 23.35	13		

Remarks

Step 9 displays number of data items (n); Step 10 displays mean value (k); Step 11 displays half-life (t-1/2).

Program for

First- and second-order reaction speeds

	Program	Remark	Step
	MODE 3 2ndF MAC MODE 2		
1	P1 2ndF MAC ‖ GSB P3 ‖	Input a	2
2	LBL 1 ‖ SHIFT ISZ ‖ GSB P4 ‖ GSB SHIFT P5 ‖	Input mi, ti	6
3	MR 01 ‖ ÷ ‖ MR 03 ‖ = ‖ ln ‖ ÷ ‖ MR 04 ‖ = ‖ M+ 06 ‖ HLT ‖	Input Ki	16
4	MR 00 ‖ − ‖ 4 ‖ = ‖ SHIFT x=0 ‖ GOTO 2 ‖ GOTO 1 ‖	4th element of data ?	23
5	LBL 2 ‖ M+ 00 ‖ MR 00 ‖ HLT ‖	Output n	27
6	MR 06 ‖ ÷ ‖ MR 00 ‖ = ‖ HLT ‖	Output ΣKi	32
7	SHIFT $1/x$ ‖ × ‖ 2 ‖ ln ‖ = ‖ HLT ‖	Output $t_{\frac{1}{2}}$	38
8			
9	P2 2ndF MAC ‖ GSB P3 ‖	Input a	2
10	"AL ‖ b ‖ a~s ? ‖ AL" ‖ HLT ‖ Min 02 ‖	Input b	8
11	LBL 1 ‖ SHIFT ISZ ‖ GSB P4 ‖	Input mi, ti	11
12	MR 01 ‖ − ‖ MR 02 ‖ = ‖ SHIFT x=0 ‖ GOTO 2 ‖	$a \doteq b$?	17
13	GSB SHIFT P5 ‖ MR 02 ‖ × ‖ MR 03 ‖ ÷ ‖ MR 01 ‖ ÷ ‖ (‖ MR 02 ‖		26
14	− ‖ MR 01 ‖ + ‖ MR 03 ‖) ‖ = ‖ ln ‖ ÷ ‖ MR 04 ‖ ÷ ‖ (‖		37
15	MR 01 ‖ − ‖ MR 02 ‖) ‖ = ‖ HLT ‖ GOTO 1 ‖	Output Ki	44
16	LBL 2 ‖ GSB SHIFT P5 ‖ (‖ MR 01 ‖ − ‖ MR 03 ‖) ‖ ÷ ‖ MR 04 ‖ ÷ ‖		54
17	MR 01 ‖ ÷ ‖ MR 03 ‖ = ‖ HLT ‖ GOTO 1 ‖	Output Ki	60
18			
19	P3 "AL ‖ a ‖ a~s ? ‖ AL" ‖ HLT ‖ Min 01 ‖	Input a	6
20			
21	P4 "AL ‖ m ‖ a~s AR 00 ‖ a~s ? ‖ AL" ‖ HLT ‖ Min 03 ‖	Input mi	7
22	"AL ‖ t ‖ a~s AR 00 ‖ a~s ? ‖ AL" ‖ HLT ‖ Min 04 ‖	Input ti	14
23			
24	SHIFT P5 "AL ‖ CAPS K ‖ a~s AR 00 ‖ = ‖ AL" ‖	Ki display	5
25			
26		Total 128	
27			
28			
29			
30			
31			
32			
33			
34			
35			
36			
37			

	Contents in memories
00	n
01	a
02	b
03	mi
04	ti
05	
06	ΣKi
07	
08	
09	
F	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
1F	
20	
21	
22	
23	
24	
25	
26	
27	
28	
29	
2F	

Note

P2 Operation:

P2 a EXE b EXE

m_1 EXE t_1 EXE → K_1

EXE m_2 EXE t_2 EXE → K_2

and repeated in the following.

The number of data (4) in the sample prodlem is set on the 4th line in the program.

Note that, since the number of program steps has been held less than 128, output comments n, k, x are not displayed.

CASIO PROGRAM SHEET

Program for	No.	
Geometrical and harmonic means	Statistics-1	

Description

• Input the program written in the next page.

① Geometrical mean $Gm = (X_1 \cdot X_2 \cdot \cdots \cdot X_n)^{\frac{1}{n}}$ → [P1]

② Harmonic mean $Hm = \dfrac{n}{\frac{1}{X_1} + \frac{1}{X_2} + \cdots + \frac{1}{X_n}}$ → [P2]

Example

What is the geometrical mean (Gm) of 2, 3.5, 6.1, 1.2 and 3.9?
What is the harmonic mean (Hm) of 2, 3.5, 6.1, 1.2 and 3.9?

Step	Data input operation	Read-out	Step	Data input operation	Read-out
	[MODE] [1]	0.	8	(Hm) [P2]	X(1) 1.
1	(Gm) [P1]	X(1) 1.	9	2 [EXE]	X(2) 0.5
2	2 [EXE]	X(2) 2.	10	3.5 [EXE]	X(3) 0.285714285
3	3.5 [EXE]	X(3) 7.	11	6.1 [EXE]	X(4) 0.163934426
4	6.1 [EXE]	X(4) 42.7	12	1.2 [EXE]	X(5) 0.833333333
5	1.2 [EXE]	X(5) 51.24	13	3.9 [EXE]	X(6) 0.256410256
6	3.9 [EXE]	X(6) 199.836	14	[GOTO] [1]	Hm= 2.451710736
7	[GOTO] [1]	Gm= 2.884926451	15		

Remarks

Program for

Geometrical and harmonic means

	Program	Remark	Step	Contents in memories	
	MODE 3 2ndF MAC MODE 2			00	
1	P1 2ndF MAC| 1 |Min 00 |Min 01 |		4	01	
2	LBL 3 |"AL |CAPS X |α-s (|α-s AR 00 |α-s) |AL"|HLT| × |		13	02	
3	MR 01 | = |Min 01 |SHIFT ISZ |GOTO 3 |		18	03	
4	LBL 1 |MR 01 |SHIFT $x\overline{y}$ | (|MR 00 | − | 1 |) | = |"AL | G |		29	04	
5	CAPS m | = |AL" |		32	05	
6				06	
7	P2 2ndF MAC| 1 |Min 00 |		3	07	
8	LBL 3 |"AL |CAPS X |α-s (|α-s AR 00 |α-s) |AL"|HLT|SHIFT $1/x$ |		12	08	
9	M+ 01 |SHIFT ISZ |GOTO 3 |		15	09	
10	LBL 1 | (|MR 00 | − | 1 |) | ÷ |MR 01 | = |"AL | H |CAPS m |		27	F	
11	= |AL" |		29	10	
12				11	
13		Total 63		12	
14				13	
15				14	
16				15	
17				16	
18				17	
19				18	
20				19	
21				1F	
22				20	
23				21	
24				22	
25				23	
26				24	
27				25	
28				26	
29				27	
30				28	
31				29	
32				2F	
33					
34					
35					
36					
37					

Note

Depress GOTO and 1 after data input.
And Gm and Hm will be displayed.

CASIO PROGRAM SHEET

Program for	No.	
n-month moving average ($n \leqq 77$)	Statistics-2	

Description

• Input the program written in the next page.

$$Y_0 = \frac{y_1 + y_2 + y_3 + \cdots + y_n}{n}$$

$$\vdots$$

$$Y_n = \frac{y_{n+1} + y_{n+2} + \cdots + y_{n+n}}{n} \qquad (n \leqq 77)$$

Example

Month	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Data	559	571	721	806	722	957	768	626	758	620	503	852	819	911	759

Calculate 12-month moving averages Y_0, Y_1, Y_2 and Y_3.

Step	Data input operation	Read-out	Step	Data input operation	Read-out
	MODE 1	0.	7	722 EXE	y 6 6.
1	PO	n = ? 0.	8	⋮	⋮
2	12 EXE	y 1 1.	9	852 EXE	Y= 705.25
3	559 EXE	y 2 2.	10	819 EXE	Y= 726.9166667
4	571 EXE	y 3 3.	11	911 EXE	Y= 755.25
5	721 EXE	y 4 4.	12	⋮	⋮
6	806 EXE	y 5 5.	13		

Remarks

Step 9 displays mean (Y_0); Step 10 displays (Y_1); Step 11 displays (Y_2).

Program for

n-month moving average ($n \leqq 77$)

	Program	Remark	Step
	MODE 3 2ndF MAC MODE 2		
1	PO 2ndF MAC ¦"AL" ¦ n ¦ = ¦ α-s ? ¦ AL" ¦ HLT ¦ Min 00 ¦		8
2	Min 1 F ¦		9
3	LBL 1 ¦ MR 1 F ¦ − ¦ MR 00 ¦ + ¦ 1 ¦ = ¦ "AL" ¦ Y ¦ α-s # ¦		19
4	AL" ¦ HLT ¦ SHIFT IND ¦ Min 00 ¦ M+ F ¦ SHIFT DSZ ¦ GOTO 1 ¦		26
5	LBL 2 ¦ MR 1 F ¦ Min 00 ¦		29
6	LBL 3 ¦ MR F ¦ ÷ ¦ MR 1 F ¦ = ¦ "AL ¦ CAPS Y ¦ = ¦ AL" ¦ HLT ¦		39
7	M+ F ¦ SHIFT IND ¦ X−M 00 ¦ M− F ¦ SHIFT DSZ ¦ GOTO 3 ¦ GOTO 2 ¦		46
8			
9		Total 47	
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			
25			
26			
27			
28			
29			
30			
31			
32			
33			
34			
35			
36			
37			

Note

	Contents in memories
00	For DSZ
01	
02	
03	
04	
05	
06	
07	
08	
09	
F	n- month sum
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
1F	n
20	
21	
22	
23	
24	
25	
26	
27	
28	
29	
2F	

CASIO PROGRAM SHEET

Program for	No.	
Spearman's coefficient of rank correlation	Statistics-3	

Description

• Input the program written in the next page.

$$r = 1 - \frac{6\Sigma(A-B)^2}{n^3 - n}$$

Example

No.	A	B
1	5	6
2	4	7
3	3	3
4	7	5
5	2	1
6	1	2
7	6	4

Calculate rank correlation coefficient for the above.

Step	Data input operation	Read-out	Step	Data input operation	Read-out
	MODE 1	0.	7		
1	P0	A 1 1.	8		
2	5 EXE	B 1 1.	9		
3	6 EXE	A 2 2.	10		
4	⋮	⋮	11		
5	4 EXE	A 8 8.	12		
6	After all data input P1	r = 0.642857142	13		

Remarks

Program for

Spearman's coefficient of rank correlation

	Program	Remark	Step
	MODE 3 2ndF MAC MODE 2		
1	PO 2ndF MAC ┘		1
2	LBL 1 ┘SHIFT ISZ ┘MR 00 ┘"AL ┘CAPS A ┘α-s # ┘AL" ┘HLT ┘— ┘		10
3	MR 00 ┘"AL ┘ B ┘α-s # ┘AL" ┘HLT ┘= ┘SHIFT x^2 ┘		18
4	M+ 01 ┘GOTO 1 ┘		20
5			
6	P1 SHIFT DSZ ┘ 1 ┘— ┘ 6 ┘× ┘MR 01 ┘÷ ┘ (┘MR 00 ┘SHIFT x^y ┘ 3 ┘		11
7	— ┘MR 00 ┘) ┘ = ┘"AL ┘CAPS r ┘ = ┘AL" ┘		19
8			
9		Total 41	
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			
25			
26			
27			
28			
29			
30			
31			
32			
33			
34			
35			
36			
37			

	Contents in memories
00	n count
01	$\Sigma(A-B)^2$
02	
03	
04	
05	
06	
07	
08	
09	
F	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
1F	
20	
21	
22	
23	
24	
25	
26	
27	
28	
29	
2F	

Note

CASIO PROGRAM SHEET

Program for	Regression analysis (linear, exponential, logarithmic, power)	No.	Statistics-4	

Description

• Input the program written in the next page.

Regression	Linear	Exponential	Logarithmic	Power
Program	[1] [PO]	[2] [PO]	[3] [PO]	[4] [PO]
Formula	$y = a + bx$	$y = a \cdot e^{bx}$ $(\ln y = \ln a + bx)$	$y = a + b\ln x$	$y = a \cdot x^b$ $(\ln y = \ln a + b\ln x)$

* Enter a value from 1 through 4 and then press [PO] to select a Particular regression formula. For example, enter [4] [PO] to select the power regression.

Coefficient $A = \frac{1}{n}(\Sigma Y - b\Sigma X)$

Coefficient $b = \frac{\Sigma XY - \frac{1}{n}\Sigma X \cdot \Sigma Y}{\Sigma X^2 - \frac{1}{n}(\Sigma X)^2} = \frac{\Sigma XY - \bar{X} \cdot \Sigma Y}{\Sigma X^2 - \bar{X} \cdot \Sigma X}$

Determinating coefficient $r^2 = \frac{A \cdot \Sigma Y + b\Sigma XY - \frac{1}{n}(\Sigma Y)^2}{\Sigma Y^2 - \frac{1}{n}(\Sigma Y)^2}$

* X, Y and A of each regression are as follows:

	Linear	Exponential	Logarithmic	Power
X	x_i	x_i	$\ln x_i$	$\ln x_i$
Y	y_i	$\ln y_i$	y_i	$\ln y_i$
A	a	$\ln a$	a	$\ln a$

Example

Exponential regression

	1	2	3	4
x_i	1.4	1.9	2.6	3.4
y_i	2.9	2.2	1.6	0.9

$x = 4.2$ . . . . . What is $\hat{y}$?

$x = 5.1$ . . . . . What is $\hat{y}$?

Step					
	[MODE] [1]	0.	6	⋮	⋮
1	2 [PO]	x 1 1.	7	After all data input [P1]	a = 6.629189137
2	1.4 [EXE]	y 1 1.	8	[EXE]	b = 0.575066534
3	2.9 [EXE]	x 2 2.	9	[EXE]	r 2 = 0.989782458
4	1.9 [EXE]	y 2 2.	10	4.2 [EXE]	y = 0.592267464
5	2.2 [EXE]	x 3 3.	11	5.1 [EXE]	y = 0.352975429

Remarks

Program for **Regression analysis (linear,exponential, logarithmic, power)**

	Program	Remark	Step	Contents in memories
	MODE 3 2ndF MAC MODE 2			00
1	PO 2ndF MAC Min 01 Min02 4 M+02		5	01
2	LBL 0 SHIFT ISZ MR00 "AL X $^{\alpha-s}$ # AL" HLT		13	02
3	SHIFT IND GOTO 1		15	03
4	LBL 4		16	04
5	LBL 3 ln		18	05
6	LBL 2		19	06
7	LBL 1 $\mathcal{X}$ D × MR 00 "AL Y $^{\alpha-s}$ # AL" HLT		28	07
8	SHIFT IND GOTO 2		30	08
9	LBL 8		31	09
10	LBL 6 ln		33	F
11	LBL 7		34	10
12	LBL 5 M+ 05 Min 03 = M+ 06 MR 03 SHIFT x^2 M+ 04 GOTO 0		43	11
13				12
14	P1 1 Min00 MR 06 − SHIFT $\bar{x}$ × MR 05 = ÷ (		10	13
15	MR 07 − SHIFT $\bar{x}$ × MR 08) = Min F		18	14
16	MR 05 ÷ MR 09 − MR F × SHIFT $\bar{x}$ = Min 03		27	15
17	SHIFT IND GOTO 2		29	16
18	LBL 0 "AL a = AL" HLT MR 03 × MR 05 +		39	17
19	MR F "AL b = AL" HLT × MR 06		47	18
20	− MR 05 SHIFT x^2 ÷ MR 09 = ÷ (MR 04 −		57	19
21	MR 05 SHIFT x^2 ÷ MR 09) = "AL r 2 =		67	1F
22	AL" HLT SHIFT IND GOTO 1		71	20
23	LBL 9 "AL Y = AL" HLT SHIFT IND GOTO 1		79	21
24	LBL 4		80	22
25	LBL 3 ln		82	23
26	LBL 2		83	24
27	LBL 1 × MR F + MR 03 = SHIFT IND GOTO 2		91	25
28	LBL 8		92	26
29	LBL 6 SHIFT e^x		94	27
30	LBL 7		95	28
31	LBL 5 SHIFT DSZ GOTO 9 GOTO 0		99	29
32				2F
33		Total 144		
34				
35				
36				
37				

Note

CASIO PROGRAM SHEET

Program for	No.
Quadratic regression analysis	Statistics–5

Description

• Input the program written in the next page.

$$y = ax^2 + bx + c$$

$$a = \frac{S_{(x^2\ y)}\, S_{(x\ x)} - S_{(x\ y)}\, S_{(x\ x^2)}}{S_{(x\ x)}\, S_{(x^2\ x^2)} - \left\{S_{(x\ x^2)}\right\}^2}$$

$$b = \frac{S_{(x\ y)}\, S_{(x^2\ x^2)} - S_{(x^2\ y)}\, S_{(x\ x^2)}}{S_{(x\ x)}\, S_{(x^2\ x^2)} - \left\{S_{(x\ x^2)}\right\}^2}$$

$$c = \frac{\Sigma y_i}{n} - b\frac{\Sigma x_i}{n} - a\frac{\Sigma x_i^2}{n}$$

$$S_{(x\ x)} = \Sigma x_i^2 - \frac{(\Sigma x_i)^2}{n}$$

$$S_{(x\ y)} = \Sigma x_i y_i - \frac{\Sigma x_i \cdot \Sigma y_i}{n}$$

$$S_{(x\ x^2)} = \Sigma x_i^3 - \frac{\Sigma x_i \cdot \Sigma x_i^2}{n}$$

$$S_{(x^2\ y)} = \Sigma x_i^2 y_i - \frac{\Sigma x_i^2 \cdot \Sigma y_i}{n}$$

$$S_{(x^2\ x^2)} = \Sigma x_i^4 - \frac{(\Sigma x_i^2)^2}{n}$$

Example

	1	2	3	4	5
x_i	1	5	8	11	15
y_i	21	30	41	54	70

Analyse the quadratic regression for the above data, and estimate y when $x = 18$ and $x = 22$.

Step	Data input operation	Read-out	Step	Data input operation	Read-out
	MODE 1	0.	7		Input xi, yi.
1	PO	x 1 1.	8	After all data input P1	a = 0.08966913
2	1 EXE	y 1 1.	9	EXE	b = 2.142880117
3	21 EXE	x 2 2.	10	EXE	c = 18.23781087
4	5 EXE	y 2 2.	11	18 EXE	y = 85.8624513
5	30 EXE	x 3 3.	12	22 EXE	y = 108.7810327
6	⋮	⋮	13		

Remarks

Step 8 displays (a); Step 9 displays (b); Step 10 displays (c);
Step 11 displays (y); Step 12 displays (y).

Program for

Quadratic regression analysis

	Program	Remark	Step
	MODE 3 2ndF MAC MODE 2		
1	P0 2ndF MAC ┘		1
2	LBL 1 ┘ SHIFT ISZ ┘ MR 00 ┘ "AL ┘ x ┘ α-s # ┘ AL" ┘ HLT ┘ x D ┘		10
3	× ┘ × ┘ = ┘ = ┘ M+ 06 ┘ = ┘ M+ 05 ┘		17
4	MR 00 ┘ "AL ┘ y ┘ α-s # ┘ AL" ┘ HLT ┘ M+ 04 ┘ = ┘		25
5	M+ 03 ┘ = ┘ M+ 02 ┘ AC ┘ GOTO 1 ┘		30
6			
7	P1 SHIFT $\bar{x}$ ┘ × ┘ × ┘ MR 04 ┘ = ┘ M− 03 ┘		6
8	MR 07 ┘ = ┘ M− 06 ┘		9
9	MR 07 ┘ ÷ ┘ MR 09 ┘ × ┘ × ┘ MR 04 ┘ = ┘ M− 02 ┘		17
10	MR 07 ┘ = ┘ M− 05 ┘		20
11	MR 07 ┘ − ┘ SHIFT $\bar{x}$ ┘ × ┘ MR 08 ┘ = ┘ Min 00 ┘ × ┘ MR 05 ┘ − ┘		30
12	MR 06 ┘ SHIFT x^2 ┘ = ┘ ÷ ┘ ÷ ┘ (┘ MR 02 ┘ × ┘ MR 00 ┘ − ┘		40
13	MR 03 ┘ × ┘ MR 06 ┘) ┘ = ┘ Min 01 ┘ "AL ┘ a ┘ = ┘		49
14	AL" ┘ HLT ┘		51
15	(┘ MR 03 ┘ × ┘ MR 05 ┘ − ┘ MR 02 ┘ × ┘ MR 06 ┘) ┘ = ┘		61
16	Min 00 ┘ "AL ┘ b ┘ = ┘ AL" ┘ HLT ┘		67
17	MR 04 ┘ ÷ ┘ MR 09 ┘ − ┘ MR 00 ┘ × ┘ SHIFT $\bar{x}$ ┘ − ┘ MR 01 ┘ × ┘		77
18	MR 07 ┘ ÷ ┘ MR 09 ┘ = ┘ Min F ┘ "AL ┘ C ┘ = ┘		85
19	"AL ┘		86
20	LBL 1 ┘ HLT ┘ Min 09 ┘ SHIFT x^2 ┘ × ┘ MR 01 ┘ + ┘ MR 09 ┘ × ┘ MR 00 ┘ + ┘		97
21	MR F ┘ = ┘ "AL ┘ y ┘ = ┘ AL" ┘ GOTO 1 ┘		104
22			
23		Total 136	
24			
25			
26			
27			
28			
29			
30			
31			
32			
33			
34			
35			
36			
37			

Note

Contents in memories		
00	Number of terms	$S(x, x)$
01		a
02	Σxi^2yi	$S(x^2, y)$
03	$\Sigma xiyi$	$S(x, y)$
04	Σyi	
05	Σxi^4	$S(x^2, y^2)$
06	Σxi^3	$S(x, x^2)$
07	Σxi^2	
08	Σxi	
09	n	x
F		c
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
1F		
20		
21		
22		
23		
24		
25		
26		
27		
28		
29		
2F		

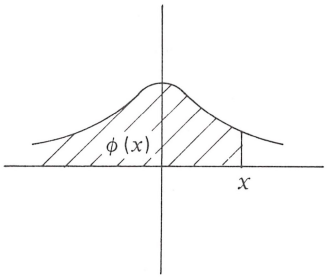
CASIO PROGRAM SHEET

Program for	Normal distribution	No.	Statistics-6	

Description

• Input the program written in the next page.

You can obtain normal distribution function $\phi(x)$ (by Hastings' best approximation).



$$\phi(x) = \int_{-\infty}^{t} \phi_t \, dx$$

$$\phi_t = \frac{1}{\sqrt{2\pi}} e^{-\frac{x^2}{2}}$$

$$\text{Put } t = \frac{1}{1 + Px}$$

$$\phi(x) \fallingdotseq 1 - \phi_t (C_1 t + C_2 t^2 + C_3 t^3 + C_4 t^4 + C_5 t^5)$$

$P = 0.2316419$ $\quad C_3 = 1.78147937$

$C_1 = 0.31938153$ $\quad C_4 = -1.821255978$

$C_2 = -0.356563782$ $\quad C_5 = 1.330274429$

Example

Calculate the values of $\phi(x)$ at $x = 1.18$ and $x = 0.7$.

Step	Data input operation	Read-out	Step	Data input operation	Read-out
	MODE 1	0.	7		
1	1.18 PO	0.880999696	8		
2	0.7 PO	0.758036136	9		
3			10		
4			11		
5			12		
6			13		

Remarks

Steps 1 and 2 display ϕ (x).

Program for

Normal distribution

	Program	Remark	Step	Contents in memories	
	MODE 3 2ndF MAC MODE 2			00	
1	PO Min 01 | × | · | 2 | 3 | 1 | 6 | 4 | 1 | 9 | + | 1 | = |		13	01	x
2	SHIFT $1/x$ | Min 02 | (| 2 | × | SHIFT π |) | SHIFT $\sqrt{}$ | SHIFT $1/x$ | × |		23	02	t
3	(| MR 01 | SHIFT x^2 | ÷ | 2 | +/− |) | SHIFT e^x | = | Min 03 |		33	03	ϕt
4	1 | − | MR 03 | × | (| · | 3 | 1 | 9 | 3 | 8 | 1 | 5 | 3 |		47	04	
5	× | MR 02 | − | · | 3 | 5 | 6 | 5 | 6 | 3 | 7 | 8 | 2 | × |		61	05	
6	MR 02 | SHIFT x^2 | + | 1 | · | 7 | 8 | 1 | 4 | 7 | 9 | 3 | 7 |		74	06	
7	× | MR 02 | SHIFT x^y | 3 | − | 1 | · | 8 | 2 | 1 | 2 | 5 | 5 |		87	07	
8	9 | 7 | 8 | × | MR 02 | SHIFT x^y | 4 | + | 1 | · | 3 | 3 | 0 |		100	08	
9	2 | 7 | 4 | 4 | 2 | 9 | × | MR 02 | SHIFT x^y | 5 |) | = |		112	09	
10				F	
11		Total 113		10	
12				11	
13				12	
14				13	
15				14	
16				15	
17				16	
18				17	
19				18	
20				19	
21				1F	
22				20	
23				21	
24				22	
25				23	
26				24	
27				25	
28				26	
29				27	
30				28	
31				29	
32				2F	
33					
34					
35					
36					
37					

Note

CASIO PROGRAM SHEET

Program for	No.	
x^2 distribution	Statistics–7	

Description

x^2 distribution probability density function.

$$f(x) = \frac{x^{\frac{\nu}{2}-1}}{2^{\frac{\nu}{2}}\,\Gamma(\frac{\nu}{2})\,e^{\frac{\nu}{2}}}$$

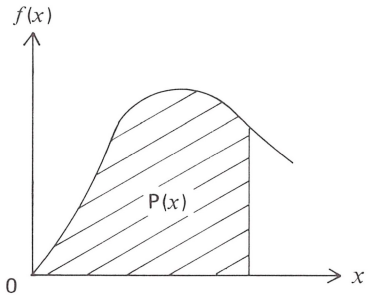
$x \geqq 0$, ν is the degree of freedom

ν : even $\quad \Gamma(\frac{\nu}{2}) = (\frac{\nu}{2}-1)!$

ν : odd $\quad \Gamma(\frac{\nu}{2}) = (\frac{\nu}{2}-1)(\frac{\nu}{2}-2)\cdots\cdots(\frac{1}{2})\cdot\sqrt{\pi}$

x^2 distribution

$$P(x) = \int_0^x f(t)dt = \frac{2x}{\nu} f(x) \left[1 + \sum_{k=1}^{\infty} \frac{x^k}{(\nu+2)(\nu+4)\cdots\cdots(\nu+2k)}\right]$$



* Calculation terminates when two successive partial sums are equal.

$$Sn = \sum_{k=1}^{n} \frac{x^k}{(\nu+2)\cdots\cdots(\nu+2k)}$$

Example

Calculate the values of $f(x)$ and $P(x)$ at $x = 8.1$ and $\nu = 4$.

Step	Data input operation	Read-out	Step	Data input operation	Read-out
	MODE 1	0.	7		
1	PO	x 0.	8		
2	8.1 EXE	v 8.1	9		
3	4 EXE	f(8.1)= 0.035280308	10		
4	EXE	P(8.1)= 0.912017008	11		
5		It takes about 12 seconds	12		
6			13		

Remarks

Program for

χ^2 distribution

	Program	Remark	Step
	MODE 3 2ndF MAC MODE 2		
1	PO 2ndF MAC ┘		1
2	"AL ┘ χ ┘AL"┘HLT┘Min 01┘"AL┘ V ┘AL"┘		9
3	HLT┘Min 02┘Min 08┘ · ┘ 5 ┘Min F ┘		15
4	MR 02┘÷┘ 2 ┘=┘Min03┘−┘ 1 ┘=┘Min 04┘MR 01┘÷┘		26
5	2 ┘=┘Min 05┘MR 01┘SHIFT x^y┘MR 04┘÷┘ 2 ┘SHIFT x^y┘		35
6	MR 03┘÷┘MR 05┘SHIFT e^x┘=┘Min 06┘MR 03┘SHIFT FRAC┘		43
7	SHIFT x=0┘GOTO 2 ┘		45
8	MR 04┘Min 03┘GOTO 5 ┘		48
9	LBL 2 ┘MR 06┘÷┘MR 04┘SHIFT $x!$┘=┘Min 06┘"AL┘ f ┘		57
10	α-s (┘α-s AR 01┘α-s) ┘=┘AL"┘HLT┘GOTO 7 ┘		64
11	LBL 4 ┘ 1 ┘M− 04┘MR 03┘×┘MR 04┘=┘Min 03┘MR 04┘		73
12	LBL 5 ┘SHIFT x=F┘GOTO 6 ┘		76
13	GOTO 4 ┘		77
14	LBL 6 ┘MR 06┘÷┘MR 03┘÷┘ SHIFT π ┘SHIFT $\sqrt{\ }$┘=┘Min 06┘"AL┘		87
15	f ┘α-s (┘α-s AR 01┘α-s) ┘=┘AL"┘HLT┘		94
16	LBL 7 ┘ 1 ┘Min 09┘ 0 ┘Min F ┘		99
17	LBL 8 ┘ 1 ┘M+ 07┘ 2 ┘M+ 08┘×┘MR 09┘=┘Min 09┘		109
18	MR 01┘SHIFT x^y┘MR 07┘÷┘MR 09┘=┘M+ 00┘		116
19	MR00┘SHIFT x=F┘GOTO 9 ┘		119
20	Min F ┘GOTO 8 ┘		121
21	LBL 9 ┘+┘ 1 ┘=┘×┘ 2 ┘×┘MR 01┘÷┘MR 02┘×┘MR 06┘=┘		134
22	"AL┘CAPS P┘α-s (┘α-s AR 01┘α-s) ┘=┘AL"┘		141
23			
24		Total 142	
25			
26			
27			
28			
29			
30			
31			
32			
33			
34			
35			
36			
37			

Note

Error will be displayed when $\nu > 141$.

	Contents in memories
00	$\sum_{k=1}^{\infty} \rightarrow P(x)$
01	x
02	ν
03	$\frac{\nu}{2}$
04	$\frac{\nu}{2} - 1$
05	$\frac{x}{2}$
06	f (x)
07	k
08	$\nu + 2$
09	$\nu + 2k$
F	$\frac{1}{2} \rightarrow \sum^{\infty}$
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
1F	
20	
21	
22	
23	
24	
25	
26	
27	
28	
29	
2F	

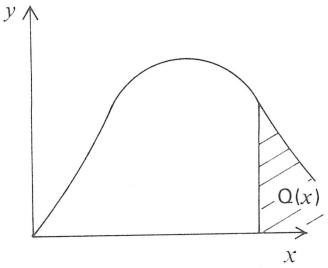
CASIO PROGRAM SHEET

Program for	No.	
F-distribution	Statistics-8	

Description

• Input the program written in the next page.

$$Q(x) = \int_x^{\infty} \frac{\Gamma\left(\frac{\nu_1+\nu_2}{2}\right) y^{\frac{\nu_1}{2}-1} \left(\frac{\nu_1}{\nu_2}\right)^{\frac{\nu_1}{2}}}{\Gamma\left(\frac{\nu_1}{2}\right)\Gamma\left(\frac{\nu_2}{2}\right)\left(1+\frac{\nu_1}{\nu_2}y\right)^{\frac{\nu_1+\nu_2}{2}}} dy$$



ν_1 and ν_2 are the degree of freedom.
Either ν_1 or ν_2 is even. If both are even, take the smaller one.

① ν_1 : even

$$Q(x) = t^{\frac{\nu_2}{2}} \left[1 + \frac{\nu_2}{2}(1-t) + \frac{\nu_2(\nu_2+2)}{2\cdot 4}(1-t)^2 + \cdots\cdots + \frac{\nu_2(\nu_2+2)\cdots(\nu_2+\nu_1-4)}{2\cdot 4\cdots\cdots(\nu_1-2)}(1-t)^{\frac{\nu_1-2}{2}}\right]$$

② ν_2 : even

$$Q(x) = 1 - (1-t)^{\frac{\nu_1}{2}} \left[1 + \frac{\nu_1}{2}t + \frac{\nu_1(\nu_1+2)}{2\cdot 4}t^2 + \cdots\cdots + \frac{\nu_1(\nu_1+2)\cdots(\nu_1+\nu_2-4)}{2\cdot 4\cdots\cdots(\nu_2-2)}t^{\frac{\nu_2-2}{2}}\right]$$

$$t = \frac{\nu_2}{\nu_2+\nu_1 x}$$

Example

Calculate $Q(x)$ for $x = 2.71$, $\nu_1 = 6$ and $\nu_2 = 7$.
Calculate $Q(x)$ for $x = 4.12$, $\nu_1 = 4$ and $\nu_2 = 10$.

Step	Data input operation	Read-out	Step	Data input operation	Read-out
	MODE 1	0.	7	4 EXE	v 2 4.
1	PO	x 0.	8	10 EXE	Q(x) = 0.031582043
2	2.71 EXE	v 1 2.71	9		
3	6 EXE	v 2 6.	10		
4	7 EXE	Q(x) = 0.109077599	11		
5	PO	x 0.109077599	12		
6	4.12 EXE	v 1 4.12	13		

Remarks

Program for

F-distribution

	Program	Remark	Step
	MODE 3 2ndF MAC MODE 2		
1	PO 2ndF MAC ¡"AL ¡ $\mathcal{X}$ ¡AL"¡HLT¡Min 01¡"AL¡ V ¡		8
2	1 ¡AL"¡HLT¡Min 02¡"AL¡ V ¡ 2 ¡AL"¡HLT¡		17
3	Min 03¡ ÷ ¡ (¡MR 03¡ + ¡MR 01¡ × ¡MR 02¡) ¡ = ¡		27
4	Min 06¡ 1 ¡Min 00¡Min 09¡Min F ¡		32
5	MR 03¡ ÷ ¡ 2 ¡ = ¡Min 05¡MR 02¡ ÷ ¡ 2 ¡ = ¡SHIFT FRAC ¡		42
6	SHIFT x=0¡GOTO 1 ¡		44
7	MR 05¡SHIFT FRAC ¡SHIFT x=0¡GOTO 5 ¡		48
8	0 ¡GOTO 9 ¡		50
9	LBL 1 ¡MR 05¡SHIFT FRAC ¡SHIFT x=0¡GOTO 2 ¡		55
10	GOTO 4 ¡		56
11	LBL 2 ¡MR 02¡ − ¡MR 03¡ = ¡SHIFT $x\geq 0$¡GOTO 5 ¡		63
12	LBL 4 ¡ 0 ¡Min 01¡Min 05¡MR 03¡Min 04¡ 1 ¡ − ¡MR 06¡ ≒ ¡		73
13	Min 07¡ (¡MR 02¡ − ¡ 2 ¡) ¡ ÷ ¡ 2 ¡ = ¡SHIFT x=F¡GOTO 7 ¡		84
14	Min F ¡GOTO 6 ¡		86
15	LBL 5 ¡ 1 ¡Min 01¡ 0 ¡Min 05¡MR 02¡Min 04¡MR 06¡Min 07¡		95
16	(¡MR 03¡ − ¡ 2 ¡) ¡ ÷ ¡ 2 ¡ = ¡SHIFT x=F¡GOTO 7 ¡Min F ¡		106
17	LBL 6 ¡ 1 ¡M+ 08¡MR 08¡SHIFT x=F¡GOTO 7 ¡		112
18	2 ¡M+ 05¡MR 09¡ × ¡MR 04¡ ÷ ¡MR 05¡ × ¡MR 07¡ = ¡		122
19	Min 09¡M+ 00¡ 2 ¡M+ 04¡GOTO 6 ¡		127
20	LBL 7 ¡MR 09¡ × ¡MR 04¡ ÷ ¡ (¡MR 05¡ + ¡ 2 ¡) ¡ × ¡MR 07¡		139
21	= ¡M+ 00¡MR 01¡SHIFT x=0¡GOTO 8 ¡		144
22	1 ¡ − ¡MR 06¡ = ¡Min 07¡ 1 ¡ − ¡MR 00¡ × ¡MR 07¡		154
23	SHIFT x^y¡ (¡MR 02¡ ÷ ¡ 2 ¡) ¡ = ¡GOTO 9 ¡		162
24	LBL 8 ¡MR 00¡ × ¡MR 06¡SHIFT x^y¡ (¡MR 03¡ ÷ ¡ 2 ¡) ¡ = ¡		173
25	LBL 9 ¡"AL¡ Q ¡α-s (¡ $\mathcal{X}$ ¡α-s) ¡ = ¡AL"¡		181
26			
27		Total 182	
28			
29			
30			
31			
32			
33			
34			
35			
36			
37			

	Contents in memories
00	Q(x)
01	x
02	$\nu 1$
03	$\nu 2$
04	Numerator
05	$\frac{\nu 2}{2}$ → Denominator
06	t
07	t or 1−t
08	Count
09	Terms of Q(x)
F	$1 \rightarrow \frac{\nu 1}{2}2$ or $\frac{\nu 2}{2}2$
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
1F	
20	
21	
22	
23	
24	
25	
26	
27	
28	
29	
2F	

Note

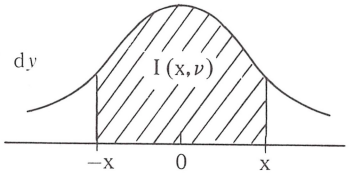
CASIO PROGRAM SHEET

Program for	No.	
t-distribution	Statistics-9	

Description

• Input the program written in the next page.

$$I(x,\nu) = \int_{-x}^{x} \frac{\Gamma\left(\frac{\nu+1}{2}\right)\left(1+\frac{y^2}{\nu}\right)^{-\frac{\nu+1}{2}}}{\sqrt{\pi\nu}\ \Gamma\left(\frac{\nu}{2}\right)}\, dy$$



$x > 0$, ν : Degree of freedom

① ν : even

$$I(x,\nu) = \sin\theta \left\{1 + \frac{1}{2}\cos^2\theta + \frac{1\cdot 3}{2\cdot 4}\cos^4\theta + \cdots + \frac{1\cdot 3\cdot 5 \cdots (\nu-3)}{2\cdot 4\cdot 6 \cdots (\nu-2)}\cos^{\nu-2}\theta\right\}$$

② ν : odd

$$I(x,\nu) = \frac{2\theta}{\pi} \quad : \nu = 1$$

$$\text{or } \frac{2\theta}{\pi} + \frac{2}{\pi}\cos\theta \left[\sin\theta \left\{1 + \frac{2}{3}\cos^2\theta + \cdots + \frac{2\cdot 4 \cdots (\nu-3)}{1\cdot 3 \cdots (\nu-2)}\cos^{\nu-3}\theta\right\}\right] \quad : \nu > 1$$

$$\theta = \tan^{-1}\left(\frac{x}{\sqrt{\nu}}\right)$$

Example

Obtain I, when x = 2.13 and ν = 10.

Step	Data input operation	Read-out	Step	Data input operation	Read-out
	MODE 1	0.	7		
1	PO	x 0.	8		
2	2.13 EXE	v 2.13	9		
3	10 EXE	I = 0.940978732	10		
4			11		
5			12		
6			13		

Remarks

Program for

t-distribution

	Program	Remark	Step
	MODE 3 2ndF MAC MODE 2		
1	PO MODE 5 ‖ 2ndF MAC ‖ "AL ‖ $\bar{x}$ ‖ AL" ‖ HLT ‖ Min 01 ‖		7
2	"AL ‖ V ‖ AL" ‖ HLT ‖ Min 02 ‖		12
3	1 ‖ Min F ‖ Min 09 ‖ Min 00 ‖		16
4	MR 01 ‖ ÷ ‖ MR 02 ‖ SHIFT $\sqrt{\ }$ ‖ = ‖ SHIFT $\tan^{-1}$ ‖ Min 01 ‖ cos ‖ SHIFT x^2 ‖		25
5	Min 06 ‖ MR 02 ‖ ÷ ‖ 2 ‖ = ‖ SHIFT FRAC ‖ SHIFT $x=0$ ‖ GOTO 2 ‖		33
6	2 ‖ × ‖ MR 01 ‖ ÷ ‖ SHIFT π ‖ = ‖ Min 03 ‖ MR 02 ‖ SHIFT $x=F$ ‖		42
7	GOTO 6 ‖		43
8	MR 02 ‖ − ‖ 1 ‖ = ‖ Min F ‖ 3 ‖ Min 07 ‖		50
9	LBL 8 ‖ 2 ‖ M+ 08 ‖ MR 08 ‖ SHIFT $x=F$ ‖ GOTO 9 ‖		56
10	MR 09 ‖ × ‖ MR 08 ‖ ÷ ‖ MR 07 ‖ × ‖ MR 06 ‖ = ‖ Min 09 ‖		65
11	M+ 00 ‖ 2 ‖ M+ 07 ‖ GOTO 8 ‖		69
12	LBL 2 ‖ MR 02 ‖ Min F ‖ 1 ‖ Min 07 ‖		74
13	LBL 3 ‖ 2 ‖ M+ 08 ‖ MR 08 ‖ SHIFT $x=F$ ‖ GOTO 4 ‖		80
14	MR 09 ‖ × ‖ MR 07 ‖ ÷ ‖ MR 08 ‖ × ‖ MR 06 ‖ = ‖ Min 09 ‖		89
15	M+ 00 ‖ 2 ‖ M+ 07 ‖ GOTO 3 ‖		93
16	LBL 4 ‖ MR 01 ‖ sin ‖ × ‖ MR 00 ‖ = ‖ GOTO 0 ‖		100
17	LBL 6 ‖ MR 03 ‖ GOTO 0 ‖		103
18	LBL 9 ‖ 2 ‖ ÷ ‖ SHIFT π ‖ × ‖ MR 01 ‖ cos ‖ × ‖ MR 01 ‖ sin ‖ × ‖ MR 00 ‖		115
19	+ ‖ MR 03 ‖ = ‖		118
20	LBL 0 ‖ "AL ‖ CAPS I ‖ = ‖ AL" ‖		123
21			
22		Total 124	
23			
24			
25			
26			
27			
28			
29			
30			
31			
32			
33			
34			
35			
36			
37			

	Contents in memories
00	Sum
01	$x \rightarrow \theta$
02	ν
03	$\frac{2\theta}{\pi}$
04	
05	
06	$\cos^2\theta$
07	Numerator calculation
08	Denominator calculation
09	n−th term
F	$1 \rightarrow \nu$ or $\nu - 1$
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
1F	
20	
21	
22	
23	
24	
25	
26	
27	
28	
29	
2F	

Note

Enter MODE 5 and specify RAD.

CASIO PROGRAM SHEET

Program for	No.
F-test	Statistics-10

Description

• Input the program written in the next page.

We test null hypothesis Ho; $\sigma_1^2 = \sigma_2^2$ for population variance σ^2 of two normal populations N (μ_1, σ_1^2) and N (μ_2, σ_2^2).

$$x = \{x_1, x_2, \cdots\cdots, x_{n1}\}$$

$$y = \{y_1, y_2, \cdots\cdots, y_{n2}\}$$

Unbiased variance of x $\quad F_1 = (\sigma_{n1-1})^2$

Unbiased variance of y $\quad F_2 = (\sigma_{n2-1})^2$

Unbiased variance ratio

Ho is rejected if $F_0 = \dfrac{F_1}{F_2} > F_{\phi_2}^{\phi_1}\left(\dfrac{\epsilon}{2}\right)$

Ho is accepted if $F_0 = \dfrac{F_1}{F_2} < F_{\phi_2}^{\phi_1}\left(\dfrac{\epsilon}{2}\right)$

where $\phi_1 = n_1 - 1$, $\phi_2 = n_2 - 1$, $F_{\phi_2}^{\phi_1}(x)$ is F-distribution, and ϵ the level of significance.

Example

A	15.2	10.4	12.3	14.5	18.6	16.3	14.3	13.6
B	18.6	19.3	16.3	19.4	16.0			

Is $\sigma_A^2 = \sigma_B^2$ in this case ?

$F_0 < F_{\phi 2}^{\phi 1}\left(\dfrac{\varepsilon}{2}\right)$ where $F_4^7(0.025) \doteqdot 9.07$

⇩

$\sigma_A^2 = \sigma_B^2$

Step	Data input operation	Read-out	Step	Data input operation	Read-out
	MODE 1	0.	7	18.6 EXE	y 2 2.
1	P0	x 1 1.	8	19.3 EXE	y 3 3.
2	15.2 EXE	x 2 2.	9	⋮	⋮
3	10.4 EXE	x 3 3.	10	16.0 EXE	y 6 6.
4	⋮	⋮	11	P2	P 1 = 7.
5	13.6 EXE	x 9 9.	12	EXE	P 2 = 4.
6	P1	y 1 1.	13	EXE	F 0 = 2.258793838

Remarks

Step 11 display (ϕ_1); Step 12 displays (ϕ_2); Step 13 displays (F_0).

Program for **F-test**

	Program	Remark	Step	Contents in memories
	MODE 3 2ndF MAC MODE 2			00
	PO 2ndF MAC		1	01
2	LBL 1 SHIFT ISZ MR 00 "AL" $\bar{x}$ α-s # AL" HLT x_D		10	02
3	GOTO 1		11	03
4				04
5	P1 MR 00 Min 01 SHIFT σ_{n-1} SHIFT x^2 Min 02 SHIFT SAC 0 Min 00		8	05
6	LBL 1 SHIFT ISZ MR 00 "AL" $\bar{y}$ α-s # AL" HLT x_D		17	06
7	GOTO 1		18	07
8				08
9	P2 2 M- 01 MR 01 "AL" p 1 = AL"		8	09
10	HLT 2 M- 00 MR 00 "AL" p 2 =		16	F
11	AL" HLT		18	10
12	MR 02 ÷ SHIFT σ_{n-1} SHIFT x^2 = "AL CAPS F 0 =		27	11
13	AL"		28	12
14				13
15		Total 60		14
16				15
17				16
18				17
19				18
20				19
21				1F
22				20
23				21
24				22
25				23
26				24
27				25
28				26
29				27
30				28
31				29
32				2F
33				
34				
35				
36				
37				

Note

CASIO PROGRAM SHEET

Program for	No.	
t-test	Statistics-11	

Description

• Input the program written in the next page.

① Test for mean μ → P0

We test null hypothesis Ho; $\mu_1 = \mu_2$ for population mean μ of two normal populations N (μ_1, ${\sigma_1}^2$) and N (μ_2, ${\sigma_2}^2$).
(Population variances ${\sigma_1}^2$ and ${\sigma_2}^2$ are unknown.)

x	x_1	x_2	·····	x_n
y	y_1	y_2	·····	y_n

$D_i = x_i - y_i$ $\quad \bar{D} = \frac{1}{n}\sum_{i=1}^{n} D_i$

$$\sigma_D = \sqrt{\frac{\Sigma D_i^2 - \frac{1}{n}(\Sigma D_i)^2}{n}}$$

$$t = \frac{\bar{D}}{\frac{\sigma_D}{\sqrt{n-1}}}$$

Let the level of significance be ϵ and t-distribution of degree of freedom ϕ be to (x).

Ho is accepted when $-t\phi(\frac{\epsilon}{2}) < t < t\phi(\frac{\epsilon}{2})$.

Ho is rejected otherwise.

where $\phi = n - 1$

Example 1

	1	2	3	4	5	6	7	8	9	10
A	43	41	41	48	44	45	40	45	46	41
B	41	40	37	48	42	42	41	42	47	43

Will results of measurement vary with A and B ?

→ $t \fallingdotseq 1.7$ $\quad t_9(0.025) = 2.262$

$\epsilon = 5\%$

$\mu_1 = \mu_2$ is accepted from $-t\phi(\frac{\epsilon}{2}) < t < t\phi(\frac{\epsilon}{2})$

Example 2

A;	15.2	10.4	12.3	14.5	18.6	16.3
	14.3	13.6				
B;	18.6	19.3	16.3	19.4	16.0	

Are A and B different ? → $\mu_1 = \mu_2$ (d=0)

$\mu_1 = \mu_2$ is rejected from

$t < -t_{11}(0.025) \fallingdotseq -2.201$

② Test for difference d of means → P2

We test null hypothesis Ho; $\mu_1 - \mu_2 = d$ for the difference of means of two normal populations.

$$x = \{x_1, x_2 \cdots\cdots, x_{n1}\} \quad , \bar{x} = \frac{1}{n1}\sum_{i=1}^{n1} x_i$$

$$y = \{y_1, y_2 \cdots\cdots, y_{n2}\} \quad , \bar{y} = \frac{1}{n2}\sum_{i=1}^{n2} y_i$$

$$t = \frac{\bar{x} - \bar{y} - d}{\sqrt{\frac{1}{n1} + \frac{1}{n2}}\sqrt{\frac{\Sigma x_i^2 - n_1\bar{x}^2 + \Sigma y_i^2 - n_2\bar{y}^2}{n_1 + n_2 - 2}}}$$

For $t\phi(\frac{\epsilon}{2})$ of $\phi = n_1 + n_2 - 2$

Ho is accepted when $-t\phi(\frac{\epsilon}{2}) < t < t\phi(\frac{\epsilon}{2})$.

Ho is rejected otherwise.

Step	Data input operation	Read-out
	MODE 1	0.
1	⟨Ex.1⟩ P0	x 1 1.
2	43 EXE	y 1 1.
3	41 EXE	x 2 2.
4	41 EXE	y 2 2.
5	⋮	⋮
6	43 EXE	x 11 11.
7	P1	P= 9.
8	EXE	t= 1.717911381
9	⟨Ex.2⟩ P2	x 1 1.
10	15.2 EXE	x 2 2.
11	⋮	⋮
12	13.6 EXE	x 9 9.
13	P3	y 1 1.
14	18.6 EXE	y 2 2.
15	⋮	⋮
16	16.0 EXE	y 6 6.
17	(d) 0 P4	P= 11.
18	EXE	t= −2.791214443
19		

Remarks

Step 7 and 17 display phase (ϕ);
Step 8 and 18 display (t).

Program for **t-test**

	Program	Remark	Step
	MODE 3 2ndF MAC MODE 2		
1	P0 2ndF MAC ▶		1
2	LBL 1 ▶ MR 09 ▶ + ▶ 1 ▶ = ▶ "AL" ▶ x ▶ α-s # ▶ AL" ▶ HLT ▶		11
3	Min 01 ▶ MR 09 ▶ + ▶ 1 ▶ = ▶ "AL" ▶ y ▶ α-s # ▶ AL" ▶		20
4	HLT ▶ Min 02 ▶ MR 01 ▶ − ▶ MR 02 ▶ = ▶ x_D ▶ GOTO 1 ▶		28
5			
6	P1 MR 09 ▶ − ▶ 1 ▶ = ▶ "AL" ▶ P ▶ = ▶ AL" ▶ HLT ▶		9
7	SHIFT $\sqrt{\ }$ ▶ × ▶ SHIFT $\bar{x}$ ▶ ÷ ▶ SHIFT σ_n ▶ = ▶ "AL" ▶ t ▶ = ▶		18
8	AL" ▶		19
9			
10	P2 2ndF MAC ▶		1
11	LBL 1 ▶ MR 09 ▶ + ▶ 1 ▶ = ▶ "AL" ▶ x ▶ α-s # ▶ AL" ▶ HLT ▶ x_D ▶		12
12	GOTO 1 ▶		13
13			
14	P3 MR 09 ▶ Min 01 ▶ MR 07 ▶ Min 02 ▶ SHIFT $\bar{x}$ ▶ Min 03 ▶ SHIFT SAC ▶		7
15	LBL 1 ▶ MR 09 ▶ + ▶ 1 ▶ = ▶ "AL" ▶ y ▶ α-s # ▶ AL" ▶ HLT ▶ x_D ▶		18
16	GOTO 1 ▶		19
17			
18	P4 Min 04 ▶ MR 01 ▶ + ▶ MR 09 ▶ − ▶ 2 ▶ = ▶ Min 05 ▶		8
19	"AL" ▶ P ▶ = ▶ AL" ▶ HLT ▶		13
20	(▶ MR 03 ▶ − ▶ SHIFT $\bar{x}$ ▶ − ▶ MR 04 ▶) ▶ ÷ ▶ (▶ MR 01 ▶		23
21	SHIFT $1/x$ ▶ + ▶ MR 09 ▶ SHIFT $1/x$ ▶) ▶ SHIFT $\sqrt{\ }$ ▶ ÷ ▶ (▶ (▶ MR 02 ▶		33
22	− ▶ MR 01 ▶ × ▶ MR 03 ▶ SHIFT x^2 ▶ + ▶ MR 07 ▶ − ▶ MR 09 ▶ × ▶		43
23	SHIFT $\bar{x}$ ▶ SHIFT x^2 ▶) ▶ ÷ ▶ MR 05 ▶) ▶ SHIFT $\sqrt{\ }$ ▶ = ▶		51
24	"AL" ▶ t ▶ = ▶ AL" ▶		55
25			
26		Total 139	
27			
28			
29			
30			
31			
32			
33			
34			
35			
36			
37			

Contents in memories		
00		
01	x^i	n_1
02	y^i	Σx_i^2
03		$\bar{x}$
04		d
05		n_1+n_2-2
06		
07	ΣD_i^2	Σy_i^2
08	ΣD_i	Σy_i
09	n	n_2
F		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
1F		
20		
21		
22		
23		
24		
25		
26		
27		
28		
29		
2F		

Note

Program for

	Program	Remark	Step
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			
25			
26			
27			
28			
29			
30			
31			
32			
33			
34			
35			
36			
37			

Note

Contents in memories	
00	
01	
02	
03	
04	
05	
06	
07	
08	
09	
F	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
1F	
20	
21	
22	
23	
24	
25	
26	
27	
28	
29	
2F	

CASIO PROGRAM SHEET

Program for	No.	
m-by-n contingency table	Statistics–12	

Description

• Input the program written in the next page.

Calculate an arbitrary contingency table as far as 5 by 5.

	1	2	····· j ·····	n	Total
A_1	x_{11}	x_{12}	····· x_{1j} ·····	x_{1n}	N_{A1}
A_2	x_{21}	x_{22}	····· x_{2j} ·····	x_{2n}	N_{A2}
A_3	x_{31}	x_{32}	····· x_{3j} ·····	x_{3n}	N_{A3}
⋮	⋮	⋮	⋮	⋮	⋮
A_i	x_{i1}	x_{i2}	····· x_{ij} ·····	x_{in}	N_{Ai}
⋮	⋮	⋮	⋮	⋮	⋮
A_m	x_{m1}	x_{m2}	····· x_{mj} ·····	x_{mn}	N_{Am}
Total	N_1	N_2	····· N_j ·····	N_n	N

$$x^2 = \frac{N}{N_{A1}} \sum_{j=1}^{n} \frac{x_{1j}^2}{N_j} + \frac{N}{N_{A2}} \sum_{j=1}^{n} \frac{x_{2j}^2}{N_j} + \cdots\cdots + \frac{N}{N_{Am}} \sum_{j=1}^{n} \frac{x_{mj}^2}{N_j} - N$$

$$= \sum_{i=1}^{m} \frac{N}{N_{Ai}} \sum_{j=1}^{n} \frac{x_{ij}^2}{N_j} - N$$

Example

	1	2	3	4
A_1	4	5	1	7
A_2	2	9	3	4
A_3	1	7	5	6

Calculate x^2 of the above 3-by-4 contingency table.

Step	Data input operation	Read-out	Step	Data input operation	Read-out
	MODE 1	0.	7	4 EXE	x 3 , 4 1.
1	PO	m 0.	8	6 EXE	X= 6.6108177
2	3 EXE	n 3.	9		
3	4 EXE	x 1 , 1 1.	10		
4	4 EXE	x 2 , 1 1.	11		
5	2 EXE	x 3 , 1 1.	12		
6	⋮	⋮	13		

Remarks

Step 8 displays (χ^2).

Program for

m-by-n contingency table

	Program	Remark	Step
	[MODE] [3] [2ndF] [MAC] [MODE] [2]		
1	PO 2ndF MAC		1
2	"AL m AL" HLT Min F Min 02		7
3	"AL n AL" HLT Min 01 2 Min 00		14
4	1 Min 58 Min 59		19
5	LBL 2 "AL x $^{\alpha-s}$AR 58 $^{\alpha-s}$, $^{\alpha-s}$AR 59 AL" HLT Min 03		30
6	M+ 1 F 3 M+ 02 MR 03 SHIFT x^2 SHIFT IND Min 02		37
7	3 6 M+ 02 MR 03 SHIFT IND M+ 02 3 9 M− 02		46
8	1 M+ 58 SHIFT IND SHIFT DSZ GOTO 2		52
9	SHIFT DSZ SHIFT IND SHIFT DSZ GOTO 3		56
10	GOTO 4		57
11	LBL 3 GSB P1 MR F Min 02 0 Min 1 F 1 Min 58 M+ 59		68
12	GOTO 2		69
13	LBL 4 GSB P1 1 7 Min 00 5 7 Min 58 MR 57 Min 1 F		81
14	LBL 6 1 M− 58 SHIFT IND MR 58 M+ 1 F SHIFT DSZ GOTO 6		91
15	2 Min 00 MR F Min 02 0 Min 60		98
16	LBL 5 3 9 M+ 02 MR 02 − 1 8 = Min 01		108
17	SHIFT IND MR 01 ÷ SHIFT IND MR 02 = M+ 60		116
18	3 9 M− 02 SHIFT IND SHIFT DSZ GOTO 5		122
19	MR 60 − 1 = × MR 1 F =		130
20	"AL CAPS X = AL"		134
21			
22	P1 2 Min 00 MR F Min 02		4
23	LBL 1 MR 02 + 2 1 0 = Min 60		11
24	3 M+ 02 SHIFT IND MR 02 ÷ MR 1 F = SHIFT IND M+ 60		20
25	3 M− 02 SHIFT IND SHIFT DSZ GOTO 1		25
26			
27		Total 161	
28			
29			
30			
31			
32			
33			
34			
35			
36			
37			

Note

	Contents in memories
00	
01	
02	
03	
04	
05	
06	
07	
08	
09	
F	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
1F	
20	
21	
22	
23	
24	
25	
26	
27	
28	
29	
2F	

CASIO PROGRAM SHEET

Program for	No.	
Removal of urea	Medicine-1	

Description

• Input the program written in the next page.

Urine generation rate $Vt = \frac{V\ [m\ell]}{t\ [min]}$

(The factor of correction Vt* by the body surface area (BSA) of a client is $\frac{1.73}{BSA}$ Vt)

① When $Vt > 2$: Maximum removal Cm [mℓ/min] and percentage mean normal <Cm>

$$Cm = \frac{UVt}{B}$$

$$<Cm> = 1.33\ Cm$$

② When $Vt \leqq 2$: Standard removal Cs [mℓ/min] and percentage mean normal <Cs>

$$Cs = \frac{U\sqrt{Vt}}{B}$$

$$<Cs> = 1.85\ Cs$$

U : Urea concentration in urine
B : Urea concentration in blood
} In any but the same unit

Example 1

Vt = 1.8 mℓ/min
U = 912 mg/100mℓ
B = 25 mg/100mℓ

Calculate Cs and <Cs> of a person whose data are given above.

Example 2

Vt = 2.5 mℓ/min
U = 823 mg/100mℓ
B = 22 mg/100mℓ
BSA = 2.11m²

Calculate Cm and <Cm> for a person whose data are given above.

Step	Data input operation	Read-out	Step	Data input operation	Read-out
	MODE 1	0.	9	2.5 EXE	INPUT U 2.5
1	PO	INPUT Vt 0.	10	823 EXE	INPUT B 823.
2	<Ex.1> 1.8 EXE	INPUT U 1.8	11	22 EXE	INPUT 22.
3	912 EXE	INPUT B 912.	12		BSA or 0 22.
4	25 EXE	INPUT 25.	13	2.11 EXE	Vt*= 2.049763033
5		BSA or 0 25.	14	EXE	Cm= 76.67977165
6	0 EXE	Cs= 48.94305589	15	EXE	<Cm>= 101.9840963
7	EXE	<Cs>= 90.5446534	16		Repeat from step 2.
8	<Ex.2> AC EXE	INPUT Vt 0.	17		

Remarks

Program for **Removal of urea**

	Program	Remark	Step
	MODE 3 2ndF MAC MODE 2		
1	P0		
2	LBL 0 GSB P2 "AL" : CAPS V CAPS t "AL" HLT Min F		9
3	GSB P2 "AL" : CAPS U "AL" HLT Min 02		16
4	GSB P2 "AL" : B "AL" HLT Min 03		23
5	GSB P2 SHIFT PAUSE "AL" B S A α-S SPACE CAPS o		31
6	r α-S SPACE 0 "AL" HLT Min 04		37
7	SHIFT x=0 GOTO 1		39
8	"AL CAPS V CAPS t α-S ✱ = "AL" SHIFT PAUSE		46
9	1 • 7 3 ÷ MR 04 × MR F = Min F HLT	Vt* calculation	57
10	LBL 1 2 SHIFT $x\geqq$F GOTO 2		61
11	"AL CAPS C CAPS m = "AL" SHIFT PAUSE GSB P1	Cm calculation	68
12	"AL α-S < CAPS C CAPS m α-S > = "AL" SHIFT PAUSE		76
13	1 • 3 3 = HLT GOTO 0	<Cm> calculation	83
14	LBL 2 "AL CAPS C CAPS s = "AL" SHIFT PAUSE		90
15	MR F SHIFT √ Min F GSB P1	Cs calculation	94
16	"AL α-S < CAPS C CAPS s α-S > = "AL" SHIFT PAUSE		102
17	1 • 8 5 = HLT GOTO 0	<Cs> calculation	109
18			
19			
20			
21	P1 MR 02 × MR F ÷ MR 03 = HLT ×		8
22			
23	P2 "AL CAPS I N P U T α-S SPACE "AL"		8
24			
25		Total 128	
26			
27			
28			
29			
30			
31			
32			
33			
34			
35			
36			
37			

	Contents in memories
00	
01	
02	U
03	B
04	BSA or O
05	
06	
07	
08	
09	
F	Vt, Vt,* $\sqrt{Vt}$ or $\sqrt{Vt}$ *
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
1F	
20	
21	
22	
23	
24	
25	
26	
27	
28	
29	
2F	

Note

The presence or absence of BSA corrections is determined automatically by whether 0 is input or not in steps 6 and 13 on the left page.

CASIO PROGRAM SHEET

Program for	No.	
Surface area of a human body	Medicine–2	

Description

• Input the program written in the next page.

DuBois's formula

$$BSA\ (D) = h^{0.725}\ (cm) \times W^{0.425}\ (kg) \times 71.84 \times 10^{-4}\ [m^2]$$

Boyde's formula (The DuBois's formula will produce large error for a child when BSA is smaller than 0.6 m^2.)

$$BSA\ (B) = h^{0.3}\ (cm) \times W^{(0.7285-0.0188 \log w)}\ (g) \times 3.207 \times 10^{-4}\ [m^2]$$

* For this program, height is input in centimeters and weight in kilograms. When BSA < 0.6, BSA is computed automatically using Boyde's formula. To find for reference the BSA computed through Boyde's formula, press [GOTO] [1] .

Example

Calculate the surface area of a person who measures 171.9 cm high and weights 61.8 kg.

Step	Data input operation	Read-out	Step	Data input operation	Read-out
	[MODE] [1]	0.	7		
1	[PO]	INPUT h→cm 0.	8		
2	171.9[EXE]	INPUT W→kg 171.9	9		
3	61.8[EXE]	BSA(D)= 1.730260272	10		
4	[GOTO] [1]	BSA(B)= 1.719450589	11		
5	[EXE]	INPUT h→cm 1.719450589	12		
6			13		

Remarks

Program for

Surface area of a human body

	Program	Remark	Step
	MODE 3 2ndF MAC MODE 2		
1	P0		
2	LBL 3 | GSB P1 | "AL | ; | h | α-S→ | c |		7
3	m | AL" | HLT | Min 01 |		11
4	GSB P1 | "AL | ; | CAPS W | α-S→ | CAPS k | g |		18
5	AL" | HLT | Min 02 |		21
6	× | 3 | SHIFT 10^x | = | Min 03 | • | 6 | Min F |		29
7	7 | 1 | • | 8 | 4 | EXP | 4 | +/− | × | MR 01 | SHIFT x^y |	BSA(D) calculation	40
8	• | 7 | 2 | 5 | × | MR 02 | SHIFT x^y | • | 4 | 2 | 5 |		51
9	= | Min 04 |		53
10	SHIFT $x \geq$ F | GOTO 2 |		55
11	GOTO 1 |		56
12	LBL 2 | "AL | CAPS B | S | A | α-S { | D | α-S) | = | AL" | SHIFT PAUSE |		67
13	MR 04 | HLT | GOTO 3 |		70
14	LBL 1 | "AL | B | S | A | α-S { | B | α-S) | = | AL" | SHIFT PAUSE |		81
15	• | 7 | 2 | 8 | 5 | − | • | 0 | 1 | 8 | 8 | × | MR 03 |	BSA(B) calculation	94
16	log | = | Min 05 | 3 | • | 2 | 0 | 7 | EXP | 4 | +/− | × |		106
17	MR 03 | SHIFT x^y | MR 05 | × | MR 01 | SHIFT x^y | • | 3 | = |		115
18	HLT | GOTO 3 |		117
19			
20			
21	P1 "AL | I | N | P | U | T | α-S SPACE | AL" |		8
22			
23		Total 127	
24			
25			
26			
27			
28			
29			
30			
31			
32			
33			
34			
35			
36			
37			

Contents in memories	
00	
01	h
02	W(kg)
03	1000W(g)
04	BSA(D)
05	0.7285-0.0188log Wg
06	
07	
08	
09	
F	0.6
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
1F	
20	
21	
22	
23	
24	
25	
26	
27	
28	
29	
2F	

Note

CASIO PROGRAM SHEET

Program for	No.	
Indication of red corpuscle	Medicine-3	

Description

• Input the program written in the next page.

○ Red cell count : C [10^6/mm^3]

○ Hematocrit : Hct [%]

○ Hemoglobin in 100 mℓ of blood : Hb [g/100mℓ]

1. Mean corpuscular volume : Vm

$$Vm = \frac{Hct \times 10}{C} \quad [micron^3 = \mu^3 = (10^{-6})^3 m^3]$$

2. Part of hemoglobin in a blood cell

$$Hm = \frac{Hb \times 10}{C} \quad [10^{-12} g = \text{pico g}]$$

3. Mean quantity of hemoglobin in 100 mℓ of blood

$$Hbm = \frac{Hb \times 100}{Hct} \quad [g/100m\ell]$$

Example

Calculate Vm, Hm and Hbm for a person whose data are 2.03 x 10^6/mm^3 for red cell count, 22.3% for Hct and 14.5g/100mℓ for Hb.

Step	Data input operation	Read-out	Step	Data input operation	Read-out
	MODE 1	0.	7	EXE	INPUT C 65.02242152
1	PO	INPUT C 0.	8		
2	2.03 EXE	INPUT Hct 2.03	9		
3	22.3 EXE	INPUT Hb 22.3	10		
4	14.5 EXE	Vm= 109.8522167	11		
5	EXE	Hm= 71.42857143	12		
6	EXE	Hbm= 65.02242152	13		

Remarks

Program for

Indication of red corpuscle

	Program	Remark	Step	Contents in memories	
	MODE 3 2ndF MAC MODE 2			00	
1	P0			01	C
2	LBL 1 | GSB P1 | "AL | ; | CAPS C | AL" | HLT | Min 01 |		8	02	Hct
3	GSB P1 | "AL | ; | H | CAPS c | ℓ | AL" |		15	03	Hb
4	HLT | Min 02 |		17	04	
5	GSB P1 | "AL | ; | CAPS H | CAPS b | AL" | HLT | Min 03 |		25	05	
6	"AL | CAPS V | CAPS m | = | AL" | SHIFT PAUSE |		31	06	
7	MR 02 | × | 1 | 0 | ÷ | MR 01 | = | HLT |	Vm calculation	39	07	
8	"AL | CAPS H | CAPS m | = | AL" | SHIFT PAUSE |		45	08	
9	÷ | MR 02 | × | MR 03 | = | HLT |	Hm calculation	51	09	
10	"AL | CAPS H | CAPS b | m | = | AL" | SHIFT PAUSE |		58	F	
11	MR 03 | × | 1 | 0 | 0 | ÷ | MR 02 | = | HLT |		67	10	
12	GOTO 1 |	Hbm calculation	68	11	
13				12	
14				13	
15	P1 "AL | CAPS I | N | P | U | T | α-S SPACE | AL" |		8	14	
16				15	
17				16	
18		Total 78		17	
19				18	
20				19	
21				1F	
22				20	
23				21	
24				22	
25				23	
26				24	
27				25	
28				26	
29				27	
30				28	
31				29	
32				2F	
33					
34					
35					
36					
37					

Note

When the number of SHIFT PAUSE is increased in the 31st, 45th, and 58th steps, the time for display of $V_m =$, $H_m =$, and $H_{bm} =$ is extended.

CASIO PROGRAM SHEET

Program for	Calculation for loan-repayment I (equally divided monthly repayment)	No.	Banking–1

Description

• Input the program written in the next page.

$$P = PV\frac{i}{1-(1+i)^{-n}} \rightarrow [P5]$$

$$PV = P\frac{1-(1+i)^{-n}}{i} \rightarrow [P6]$$

$$n = -\frac{\ln\left(1-\frac{i \cdot PV}{P}\right)}{\ln(1+i)} \rightarrow [P7]$$

P : Amount of monthly repayment · · [P0]

PV: Amount of loan · · · · · · · · · · · · [P1]

i : Monthly interest (input data is annual interest) · · · · · · · · · · · · [P3]

n : Number of times of repayment · · [P2]

The amount of repayment will be calculated in units of 1,000 Yen by counting 500 Yen or more as 1,000 Yen and disregarding the rest.

Example 1: We borrow 3 million Yen at an annual interest of 7.65% for 10 years. What is the amount of monthly repayment ?

Example 2: What is the amount of monthly repayment under the same loan conditions as Example 1 but that the annual interest is 5.05% ?

Example 3: With a monthly repayment of ¥45,000, annual interest of 7.5%, and term of loan of 15 years, how much money can be borrowed?

Example 4: For a loan of ¥6,000,000 at annual interest of 5.5% and monthly payments of ¥84,000, how many months (years) will it take to repay the loan in full?

Step	Data input operation	Read-out	Step	Data input operation	Read-out
	[MODE] [1]	0.	8	(n) 15 [P2]	n= 180.
1	⟨Ex.1⟩ (PV) 300 [P1]	3000000.	9	(i) 7.5 [P3]	i= 0.625
2	(i) 7.65 [P3]	i= 0.6375	10	[SHIFT] [P6]	PV= 4854304.
3	(n) 10 [P2]	n= 120.	11	⟨Ex.4⟩ (PV) 600 [P1]	6000000.
4	[SHIFT] [P5]	P= 36000.	12	(i) 5.5 [P3]	i= 0.458333333
5	⟨Ex.2⟩ (i) 5.05 [P3]	i= 0.420833333	13	(P) 84000 [P0]	P= 84000.
6	[SHIFT] [P5]	P= 32000.	14	[SHIFT] [P7]	M= 87.
7	⟨Ex.3⟩ (P) 45000 [P0]	P= 45000.	15	[EXE]	Y= 7.25

Remarks

Steps 4 and 6 display the amount due; Step 10 displays the loan amount; Step 14 displays the number of months; Step 15 displays the number of years.

Program for **Calculation for loan-repayment I (equally divided monthly repayment)**

	Program	Remark	Step
	MODE 3 2ndF MAC MODE 2		
1	P1 EXP 4 Min 01		3
2			
3	P2 × 1 2 = Min 02 "AL n = AL"		9
4			
5	P3 ÷ 1 2 0 0 × Min 03 2 SHIFT 10^x = "AL		11
6	i = AL"		14
7			
8	P0 Min 00 "AL CAPS P = AL"		5
9			
10	SHIFT P5 GSB P4 × MR 01 = Min 00 ÷ 3 SHIFT 10^x + • 5		11
11	= SHIFT INT × 3 SHIFT 10^x = "AL P =		20
12	AL"		21
13			
14	SHIFT P6 GSB P4 SHIFT $1/x$ × MR 00 GSB SHIFT P9 Min 01 "AL P		8
15	V = AL"		11
16			
17	SHIFT P7 1 − MR 03 × MR 01 ÷ MR 00 = ln ÷		10
18	GSB SHIFT P8 ln +/− GSB SHIFT P9 Min 02 "AL M =		18
19	AL" HLT ÷ 1 2 = "AL Y =		27
20	AL"		28
21			
22	P4 MR 03 ÷ (1 − GSB SHIFT P8 SHIFT x^y MR 02 +/− =		10
23			
24	SHIFT P9 = Min 05 + • 5 = SHIFT INT		7
25			
26	SHIFT P8 (1 + MR 03)		5
27			
28		Total 123	
29			
30			
31			
32			
33			
34			
35			
36			
37			

	Contents in memories
00	P
01	PV
02	n
03	i
04	
05	
06	
07	
08	
09	
F	
20	
11	
12	
13	
14	
15	
16	
17	
18	
19	
1F	
20	
21	
22	
23	
24	
25	
26	
27	
28	
29	
2F	
10	

Note

P0 = Amount of repayment
P1 = Amount of loan
P2 = Term of loan
P3 = Rate of interest

} When pressed after SHIFT, each answer can be determined.

MR O O allows a check of amount of repayment before fractions are processed.

MR O 1 allows check of amount of loan before fractions are processed.

CASIO PROGRAM SHEET

Program for	No.	
Calculation for loan-repayment II (Interest on equally divided monthly repayment)	**Banking–2**	

Description

• Input the program written in the next page.

This program determines interest i from $PV = P\dfrac{1-(1+i)^{-n}}{i}$

(Method) Newton's approximate expressions are used.

$$i_{(k+1)} = i_k - \frac{f_{(ik)}}{f'_{(ik)}}$$

$$f_{(ik)} = PV - \frac{P}{i}\left\{1-(1+i)^{-n}\right\}$$

$$f'_{(ik)} = PV - \frac{P}{i}\left\{n(1+i)^{-n-1} - \frac{1-(1+i)^{-n}}{i}\right\}$$

[Preliminary values] $i_{(0)} = \dfrac{P}{PV} - \dfrac{PV}{n^2P}$ Considered as convergence where $|i_{(k+1)} - i_k| \leqq 10^{-8}$

[P0] – Amount of monthly repayment (P)
[P1] – Amount of loan (PV)
[P2] – Number of months (n)
[P3] – Monthly interest (i%)

Example 1: ¥3,000,000 was borrowed, and returned over a period of 15 years with monthly repayments of ¥28,000. What was the interest rate (in %)?

Example 2: Recalculate Example 1 for a period of 200 months.

Example 3: ¥54,000,000 was borrowed, and returned over 150 months at monthly repayments of ¥490,000. What was the interest rate?

Step	Data input operation	Read-out	Step	Data input operation	Read-out
	MODE 1	0.	7	SHIFT P8	i(M)= 0.703781279
1	⟨Ex.1⟩ (PV) 300 P1	3000000.	8	EXE	i(Y)= 8.445375348
2	(n) 15 × 12 = P2	n= 180.	9	⟨Ex.3⟩ (PV) 5400 P1	54000000.
3	28000 P0	P= 28000.	10	(P) 490000 P0	P= 490000.
4	SHIFT P8	i(M)= 0.634252963	11	(n) 150 P2	n= 150.
5	EXE	i(Y)= 7.611035557	12	SHIFT P8	i(M)= 0.432302894
6	⟨Ex.2⟩ (n) 200 P2	n= 200.	13	EXE	i(Y)= 5.187634729

Remarks

Steps 4, 7, and 12 display the monthly interest; Steps 5, 8, and 13 display the annual interest rate.

Program for **Calculation for loan-repayment II (Interest on equally divided monthly repayment)**

	Program	Remark	Step
	MODE 3 2ndF MAC MODE 2		
1	P1 EXP 4 Min 01		3
2			
3	P0 Min 00 "AL CAPS P = "AL"		5
4			
5	P2 Min 02 "AL CAPS η "AL"		5
6			
7	SHIFT P8 8 +/- SHIFT 10^x Min F		4
8	MR 00 ÷ MR 01 − MR 01 ÷ MR 02 SHIFT x^2 ÷		13
9	MR 00 = Min 04		16
10	LBL 1 MR 04 Min 05 − (MR 01 − (MR 00 ÷ MR 05		27
11	) Min 06 × (1 − ((1 + MR 05)		39
12	Min 07 SHIFT x^y MR 02 +/-) Min 08) Min 09) ÷		49
13	(MR 01 − MR 06 × (MR 02 × MR 08 ÷		59
14	MR 07 − MR 09 ÷ MR 05)) = Min 04 −		69
15	MR 05 = SHIFT ABS SHIFT $x \geq$ F GOTO 1		74
16	MR 04 Min 03 × 2 SHIFT 10^x = "AL i α-s (		83
17	CAPS M α-s) = "AL" HLT × 1 2 = "AL		93
18	CAPS i α-s (CAPS Y α-s) = "AL"		99
19			
20		Total 116	
21			
22			
23			
24			
25			
26			
27			
28			
29			
30			
31			
32			
33			
34			
35			
36			
37			

	Contents in memories
00	P
01	PV
02	n
03	i
04	$i(k+1)$
05	ik
06	P/i
07	$1+ik$
08	$(1+ik)^{-n}$
09	$1-(1+i^k)^{-n}$
F	1×10^{-8}
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
1F	
20	
21	
22	
23	
24	
25	
26	
27	
28	
29	
2F	

Note

CASIO PROGRAM SHEET

Program for	No.	
Calculation of compound annual interest	Banking–3	

Description

• Input the program written in the next page.

1. Calculation of present value of compound interest annuity

   A. End-of-term payment → [P3] (formula) $P = R\dfrac{1-\dfrac{1}{(1+i)^n}}{i}$

   B. Beginning-of-term payment → [P4] (formula) $P = R(1+i)\dfrac{1-\dfrac{1}{(1+i)^n}}{i}$

2. Calculation of full-term value of compound interest annuity

   A. End-of-term payment → [P5] (formula) $S = R\dfrac{(1+i)^n-1}{i}$

   B. Beginning-of-term payment → [P6] (formula) $S = R(1+i)\dfrac{(1+i)^n-1}{i}$

3. Calculation of accumulated funds → [P5] (formula) $FV = PMT\dfrac{(1+i)^n-1}{i}$

P: Present value of annuity
R: Amount of annuity ····· [P0]
n: Period ····· [P2]
PMT: Amount accumulated ····· [P0]
S: Full-term value of annuity
i: Interest ····· [P1]
FV: Full-term value of compound interest

The answer is rounded off (under 0.5 cut off, 0.5 and above rounded up) to the nearest yen.

Example:

In order to provide a yearly annuity of ¥350,000 for the next 10 years, how much present value is required? Assume yearly interest of 5.5%, and determine the amounts required for end-of-term and first-of-term payments respectively.
How much present value is required to provide the same annuity for 20 years?
How much to provide an annuity of ¥1,000,000 for 20 years?

Step	Data input operation	Read-out	Step	Data input operation	Read-out
	[MODE] [1]	0.	7	[P3]	P= 4182634.
1	(R) 350000 [P0]	R= 350000.	8	[P4]	P= 4412679.
2	(i) 5.5 [P1]	i= 0.055	9	(R) 1000000 [P0]	R= 1000000.
3	(n) 10 [P2]	n= 10.	10	[P3]	P= 11950382.
4	[P3]	P= 2638169.	11	[P4]	P= 12607654.
5	[P4]	P= 2783268.	12		
6	(n) 20 [P2]	n= 20.	13		

Remarks

Steps 4, 7, and 10 display end of period payment; Steps 5, 8, and 11 display beginning of period payment.

Program for **Calculation of compound annual interest**

	Program	Remark	Step
	MODE 3 2ndF MAC MODE 2		
1	P0 Min 00 "AL CAPS R = AL"		5
2			
3	P1 ÷ 2 SHIFT 10^x = Min 01 GSB SHIFT P9 MR 01 "AL		8
4	CAPS i = AL"		11
5			
6	P2 Min 02 GSB SHIFT P9 MR 02 "AL n =		6
7	AL"		8
8			
9	SHIFT P9 (1 + MR 01) Min 03 SHIFT x^y MR 02 = Min 04		10
10	(1 − MR 04 SHIFT $1/x$) ÷ MR 01 = Min 05		20
11	(MR 04 − 1) ÷ MR 01 = Min 06		29
12			
13	P3 MR 00 × MR 05 GSB SHIFT P8 "AL CAPS P =		7
14	AL"		8
15			
16	P4 MR 00 × MR 03 × MR 05 GSB SHIFT P8 "AL P =		9
17	AL"		10
18			
19	SHIFT P5 MR 00 × MR 06 GSB SHIFT P8 "AL S =		7
20	AL"		9
21			
22	SHIFT P6 MR 00 × MR 03 × MR 06 GSB SHIFT P8 "AL S =		9
23	AL"		10
24			
25	SHIFT P8 + • 5 = SHIFT INT		5
26			
27		Total 102	
28			
29			
30			
31			
32			
33			
34			
35			
36			
37			

	Contents in memories
00	R(PMT)
01	i
02	n
03	$1+i$
04	$(1+i)^n$
05	
06	
07	
08	
09	
F	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
1F	
20	
21	
22	
23	
24	
25	
26	
27	
28	
29	
2F	

Note

Interest is given as annual interest, in % units.

CASIO PROGRAM SHEET

Program for	No.	
Calculation of compound annual interest	Banking–3	

Description

• Input the program written in the next page.

1. Calculation of present value of compound interest annuity

   A. End-of-term payment → [P3] (formula) $P = R\dfrac{1-\dfrac{1}{(1+i)^n}}{i}$

   B. Beginning-of-term payment → [P4] (formula) $P = R(1+i)\dfrac{1-\dfrac{1}{(1+i)^n}}{i}$

2. Calculation of full-term value of compound interest annuity

   A. End-of-term payment → [P5] (formula) $S = R\dfrac{(1+i)^n-1}{i}$

   B. Beginning-of-term payment → [P6] (formula) $S = R(1+i)\dfrac{(1+i)^n-1}{i}$

3. Calculation of accumulated funds → [P5] (formula) $FV = PMT\dfrac{(1+i)^n-1}{i}$

P: Present value of annuity
R: Amount of annuity ····· [P0]
n: Period ····· [P2]
PMT: Amount accumulated ····· [P0]
S: Full-term value of annuity
i: Interest ····· [P1]
FV: Full-term value of compound interest

The answer is rounded off (under 0.5 cut off, 0.5 and above rounded up) to the nearest yen.

Example:

In order to provide a yearly annuity of ¥350,000 for the next 10 years, how much present value is required? Assume yearly interest of 5.5%, and determine the amounts required for end-of-term and first-of-term payments respectively.
How much present value is required to provide the same annuity for 20 years?
How much to provide an annuity of ¥1,000,000 for 20 years?

Step	Data input operation	Read-out	Step	Data input operation	Read-out
	[MODE] [1]	0.	7	[P3]	P= 4182634.
1	(R) 350000 [P0]	R= 350000.	8	[P4]	P= 4412679.
2	(i) 5.5 [P1]	i= 0.055	9	(R) 1000000 [P0]	R= 1000000.
3	(n) 10 [P2]	n= 10.	10	[P3]	P= 11950382.
4	[P3]	P= 2638169.	11	[P4]	P= 12607654.
5	[P4]	P= 2783268.	12		
6	(n) 20 [P2]	n= 20.	13		

Remarks

Steps 4, 7, and 10 display end of period payment; Steps 5, 8, and 11 display beginning of period payment.

Program for

Calculation of compound annual interest

	Program	Remark	Step
	MODE 3 2ndF MAC MODE 2		
1	P0 Min 00 "AL CAPS R = AL"		5
2			
3	P1 ÷ 2 SHIFT 10^x = Min 01 GSB SHIFT P9 MR 01 "AL		8
4	CAPS i = AL"		11
5			
6	P2 Min 02 GSB SHIFT P9 MR 02 "AL n =		6
7	AL"		8
8			
9	SHIFT P9 (1 + MR 01) Min 03 SHIFT x^y MR 02 = Min 04		10
10	(1 − MR 04 SHIFT $1/x$) ÷ MR 01 = Min 05		20
11	(MR 04 − 1) ÷ MR 01 = Min 06		29
12			
13	P3 MR 00 × MR 05 GSB SHIFT P8 "AL CAPS P =		7
14	AL"		8
15			
16	P4 MR 00 × MR 03 × MR 05 GSB SHIFT P8 "AL P =		9
17	AL"		10
18			
19	SHIFT P5 MR 00 × MR 06 GSB SHIFT P8 "AL S =		7
20	AL"		9
21			
22	SHIFT P6 MR 00 × MR 03 × MR 06 GSB SHIFT P8 "AL S =		9
23	AL"		10
24			
25	SHIFT P8 + • 5 = SHIFT INT		5
26			
27		Total 102	
28			
29			
30			
31			
32			
33			
34			
35			
36			
37			

	Contents in memories
00	R(PMT)
01	i
02	n
03	$1+i$
04	$(1+i)^n$
05	
06	
07	
08	
09	
F	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
1F	
20	
21	
22	
23	
24	
25	
26	
27	
28	
29	
2F	

Note

Interest is given as annual interest, in % units.

CASIO PROGRAM SHEET

Program for	Calculation for discounting commercial bills (by annual interest basis)	No.	Banking–4	

Description

$$a_1 \times \frac{b_1}{100} \times c_1 \div 365 = d_1$$

$$\vdots$$

$$a_n \times \frac{b_n}{100} \times c_n \div 365 = d_n$$

$$\Sigma a_n \qquad \Sigma d_n$$

$$\Sigma a_n - \Sigma d_n - e = f$$

The discount charge and commission will be rounded off to units of yen.

• Input the program written in the next page.

a : Value of bill

b : Annual interest (%)

c : Number of days

d : Discount charge

e : Commission

Σa_n: Total value of bills

Σd_n: Total interest

f : Net money receivable

Example

	a (Yen)	b (%)	c (Days)	d (Yen)
1	1,258,250	8.00	56	15,443
2	3,697,120	8.75	115	101,924
3	876,321	7.50	83	14,945
Σan	5,831,691		Σdn	132,312
			e	750
			f	5,698,629

Step	Data input operation	Read-out	Step	Data input operation	Read-out
	MODE 1	0.	7	115 EXE	d 2= 101924.
1	PO	a 1 0.	8	876321 EXE	b 3 876321.
2	1258250 EXE	b 1 1258250.	9	7.5 EXE	c 3 7.5
3	8 EXE	c 1 8.	10	83 EXE	d 3= 14945.
4	56 EXE	d 1 15443.	11	P1	Σ a 3= 5831691.
5	3697120 EXE	b 2 3697120.	12	EXE	Σ d 3= 132312.
6	8.75 EXE	c 2 8.75	13	750 EXE	f = 5698629.

Remarks

Program for **Calculation for discounting commercial bills (by annual interest basis)**

	Program	Remark	Step
	MODE 3 2ndF MAC MODE 2		
1	P0 2ndF MAC		1
2	SHIFT ISZ "AL" a 1 "AL"		6
3	LBL 1 HLT Min 01 M+ 02 "AL" b α-S AR00 "AL" HLT		15
4	Min 03 "AL" c α-S AR00 "AL" HLT × MR 01		23
5	× MR 03 ÷ 3 6 5 0 0 = SHIFT INT M+ 04		34
6	"AL" d α-S AR00 = "AL" SHIFT ISZ		40
7	GOTO 1		41
8			
9	P1 SHIFT DSZ MR 02 "AL" α-S Σ a α-S AR00 =		7
10	"AL" HLT − MR 04 "AL" α-S Σ d		14
11	α-S AR00 = "AL" HLT − MR 04 = "AL"		22
12	f = "AL"		25
13			
14		Total 68	
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			
25			
26			
27			
28			
29			
30			
31			
32			
33			
34			
35			
36			
37			

	Contents in memories
00	
01	a
02	Σan
03	b
04	Σdn
05	
06	
07	
08	
09	
F	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
1F	
20	
21	
22	
23	
24	
25	
26	
27	
28	
29	
2F	

Note

CASIO PROGRAM SHEET

Program for	No.
Calculating for depreciation	Banking-5

Description

• Input the program written in the next page.

P; Purchase cost
r; Residual value (%)
R; Rate of depreciation
n; Service life
m; Settlement of accounts in times per year
Q; Amount of depreciation

① Fixed instalment method → [P1]

$R = \frac{1}{n}$ (Round off at the fourth decimal place)

When m = 2, R = ½n. Round up the fourth decimal digit.

$Q = P(1 - \frac{r}{100}) \times R$

② Fixed percentage method → [P2]

$R = 1 - r^{\frac{1}{nm}}$

$Q = P \times R$

Book value S = P − Q
Total depreciation T

Ex. 1. Calculate Q by the fixed instalment method when P = 1,000,000 Yen, r = 10%, n = 6, and m = 1.

Ex. 2. Tabulate depreciation value by the fixed percentage method when P = 1,000,000 Yen, r = 10%, n = 3, and m = 2.

Settlement of accounts	Depreciation value Q	Book value S
1st	319000	681000
2nd	217239	463761
3rd	147939	315822
4th	100747	215075
5th	68608	146467
6th	46722	99745
Total	900255	

Step	Data input operation	Read-out	Step	Data input operation	Read-out
	[MODE] [1]	0.	8	10 [EXE]	n 0.1
1	‹Ex.1› [P1]	P 0.	9	3 [EXE]	m 3.
2	1000000 [EXE]	r 1000000.	10	2 [EXE]	Q1= 319000.
3	10 [EXE]	n 0.1	11	[EXE]	S1= 681000.
4	6 [EXE]	m 6.	12	[EXE]	Q2= 217239.
5	1 [EXE]	Q= 149400.	13	⋮	⋮
6	‹Ex.2› [P2]	P= 149400.	14	[EXE]	S6= 99745.
7	1000000 [EXE]	r 1000000.	15	[EXE]	T= 900255.

Remarks

Program for **Calculating for depreciation**

	Program	Remark	Step	Contents in memories
	MODE 3 2ndF MAC MODE 2			00
1	P1 GSB P3		1	01
2	Min F MR 03 SHIFT $1/x$ × 3 SHIFT 10^x GSB P0		8	02
3	1 SHIFT $x=f$ GOTO 1		11	03
4	MR 05 ÷ 2 × 3 SHIFT 10^x + • 5 GSB P0		21	04
5	LBL 1 MR 01 × (1 − MR 02) × MR 05 =		32	05
6	"AL CAPS Q = AL"		36	06
7				07
8	P2 GSB P3 × MR 03 = Min 00		5	08
9	1 − MR 02 SHIFT $x\frac{1}{y}$ MR 00 = SHIFT RND 3 Min 05		13	09
10	LBL 1 1 M+ 06 MR 01 × MR 05 = SHIFT INT Min 07 M+ 08		23	F
11	"AL Q α-S AR 06 = AL" HLT		29	10
12	MR 01 − MR 07 = Min 01 "AL S α-S AR 06 =		38	11
13	AL" HLT SHIFT DSZ GOTO 1		42	12
14	MR 08 "AL T = AL"		47	13
15				14
16	P0 = SHIFT INT ÷ 3 SHIFT 10^x = Min 05		7	15
17				16
18	P3 2ndF MAC		1	17
19	"AL P AL" HLT Min 01 "AL CAPS R AL" HLT		10	18
20	÷ 2 SHIFT 10^x = Min 02 "AL n AL" HLT		19	19
21	Min 03 "AL m AL" HLT Min 04		25	1F
22				20
23		Total 119		21
24				22
25				23
26				24
27				25
28				26
29				27
30				28
31				29
32				2F
33				
34				
35				
36				
37				

Note

CASIO PROGRAM SHEET

Program for	Calculation of aggregate classification and prorating	No.	Banking–6	

Description

• Input the program written in the next page.

Item	Amount	%
1		
2		
3		
:		
:		
N		
Total		

Perform aggregate classification after inputting data of all bills, and determine amount and percentage of each amount.
The percentage will be obtained to the second decimal place by rounding off the third decimal.

Example

Code	Amount
3	2,870
2	1,960
5	3,850
7	2,690
9	1,890
5	1,250
8	3,300
7	1,960
1	2,500
2	2,310
6	3,190
5	4,370
3	5,360
1	2,220
8	3,880
2	1,450
4	6,120
9	3,600
9	2,000
1	3,100
3	1,850

Code	Amount	%
1	7,820	12.67
2	5,720	9.27
3	10,080	16.33
4	6,120	9.92
5	9,470	15.34
6	3,190	5.17
7	4,650	7.53
8	7,180	11.63
9	7,490	12.14
Total	61,720	100

Step	Data input operation	Read-out	Step	Data input operation	Read-out
	MODE 1	0.	7	After all data input P1	T= 61720.
1	PO	No.? 0.	8	EXE	No.1= 7820.
2	3 EXE	No.3→DATA? 3.	9	EXE	P= 12.67
3	2870 EXE	No.? 2870.	10	EXE	No.2= 5720.
4	2 EXE	No.2→DATA? 2.	11	⋮	⋮
5	1960 EXE	No.? 1960.	12	EXE	P= 12.14
6	⋮	Repeat these steps	13	EXE	TP= 100.

Remarks

Step 7 displays the total; Step 8 displays Code 1 total; Step 9 displays Code 1 rate; Step 10 displays Code 2 total; Step 12 displays Code 9 rate; Step 13 displays total rate.

Program for **Calculation of aggregate classification and prorating**

	Program	Remark	Step	Contents in memories
	MODE 3 2ndF MAC MODE 2			00
1	PO 2ndF MAC		1	01
2	LBL 1 "AL CAPS N CAPS O • α-s ? AL" HLT Min 00 SHIFT $x \geq$ F		11	02
3	Min F "AL CAPS N CAPS O • α-s AR 00 α-s $\Rightarrow$ CAPS D A		20	03
4	T A α-s ? AL" HLT SHIFT IND M+ 00 GOTO 1		28	04
5				05
6	P1 MR F Min 00 AC		3	06
7	LBL 1 + SHIFT IND MR 00 SHIFT DSZ		8	07
8	GOTO 1 = "AL T = AL" HLT SHIFT ISZ		16	08
9	÷ 4 SHIFT 10^x = X-M 01 GSB P4 SHIFT ISZ		23	09
10	X-M 02 GSB P4 M+ 02 2 Min 00 SHIFT x=F GOTO 3		30	F
11	LBL 2 SHIFT ISZ SHIFT IND MR 00 GSB P4 M+ 02		36	10
12	MR 00 SHIFT x=F GOTO 3 GOTO 2		40	11
13	LBL 3 MR 02 "AL T P = AL"		47	12
14				13
15	P4 "AL N CAPS O • α-s AR 00 = AL" HLT		8	14
16	÷ MR 01 + • 5 = SHIFT INT ÷ 2 SHIFT 10^x =		19	15
17	"AL CAPS P = AL" HLT		24	16
18				17
19		Total 102		18
20				19
21				1F
22				20
23				21
24				22
25				23
26				24
27				25
28				26
29				27
30				28
31				29
32				2F
33				
34				
35				
36				
37				

Note

CASIO PROGRAM SHEET

Program for	No.	
Horizontal/vertical aggregate calculations	Banking–7	

Description

• Input the program written in the next page.

	x_1	x_2	x_3	x_4	···	···	···	x_n	Total
y_1									
y_2									
y_3									
⋮									
⋮									
⋮									
y_m									
Total									

y_m terms are arbitrary.

x_n terms are 73 terms or less.

Example

	x_1	x_2	x_3	x_4	x_5	Total
y_1	23	26	2	50	32	133
y_2	19	46	11	19	10	105
y_3	79	54	22	30	86	271
y_4	35	11	15	12	5	78
y_5	19	11	39	20	21	110
y_6	77	71	58	92	26	324
y_7	23	50	36	47	41	197
y_8	2	39	24	9	16	90
y_9	17	38	50	37	53	195
Total	294	346	257	316	290	1503

Step	Data input operation	Read-out	Step	Data input operation	Read-out
	MODE 1	0.	8	19 EXE	Y 2 − x 2 ? 1.
1	(n) 5 PO	Y 1 − x 1 ? 5.	9	⋮	Repeat these steps
2	23 EXE	Y 1 − x 2 ? 1.	10	After all data input P1	x 1 = 294.
3	26 EXE	Y 1 − x 3 ? 1.	11	EXE	x 2 = 346.
4	2 EXE	Y 1 − x 4 ? 1.	12	EXE	x 3 = 257.
5	50 EXE	Y 1 − x 5 ? 1.	13	EXE	x 4 = 316.
6	32 EXE	Y 1 = 133.	14	EXE	x 5 = 290.
7	EXE	Y 2 − x 1 ? 5.	15	EXE	Σx = 1503.

Remarks

Step 1 displays (y1, x1) input; Step 2 displays (y1, x2) input; Step 6 displays (y1 horizontal sum); Steps 10 through 14 display vertical sums of x1 through x5; Step 15 displays total.

Program for **Horizontal/vertical aggregate calculations**

	Program	Remark	Step	Contents in memories
	MODE 3 2ndF MAC MODE 2			00
1	P0 2ndF MAC ▷ Min F ▷ GOTO 2 ▷		3	01
2	LBL 1 ▷ "AL ▷ y ▷ α-S AR 1 F ▷ − ▷ x ▷ α-S AR 2 F ▷ α-S ? ▷		12	02
3	AL" ▷ HLT ▷ SHIFT IND ▷ M+ 00 ▷ M+ 3 F ▷ 1 ▷ M+ 2 F ▷		21	03
4	SHIFT DSZ ▷ GOTO 1 ▷		23	04
5	MR 3 F ▷ "AL ▷ y ▷ α-S AR 1 F ▷ = ▷ AL" ▷ HLT ▷		31	05
6	LBL 2 ▷ 1 ▷ M+ 1 F ▷ Min 2 F ▷ 0 ▷ Min 3 F ▷ MR F ▷ Min 00 ▷ GOTO 1 ▷		42	06
7				07
8	P1 MR F ▷ Min 00 ▷ 0 ▷ Min 1 F ▷ Min 2 F ▷		6	08
9	LBL 1 ▷ 1 ▷ M+ 1 F ▷ SHIFT IND ▷ MR 00 ▷ M+ 2 F ▷		13	09
10	"AL ▷ x ▷ α-S AR 1 F ▷ = ▷ AL" ▷ HLT ▷		19	F
11	SHIFT DSZ ▷ GOTO 1 ▷		21	10
12	MR 2 F ▷ "AL ▷ α-S Σ ▷ x ▷ = ▷ AL" ▷		27	11
13				12
14		Total 72		13
15				14
16				15
17				16
18				17
19				18
20				19
21				1F
22				20
23				21
24				22
25				23
26				24
27				25
28				26
29				27
30				28
31				29
32				2F
33				
34				
35				
36				
37				

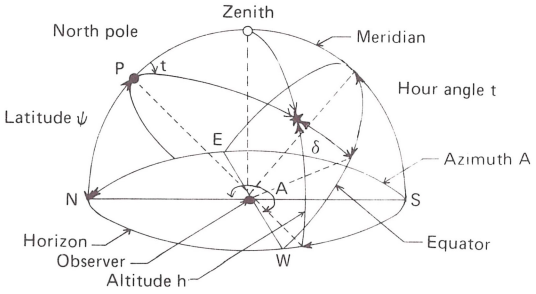
Note

CASIO PROGRAM SHEET

Program for	No.
Astronomical observation	**Navigation–1**

Description

• Input the program written in the next page.



We use the first equatorial system.

Latitude of observer ψ; $+90^\circ \sim -90^\circ$
(Identify south latitude by a minus sign.)

Declination δ; $+90^\circ \sim -90^\circ$
(Identify south of the equator by a minus sign.)

Hour angle t; Measure hour angle from the intersection of the equator and meridian in the direction of the diurnal motion of the celestial sphere.

Altitude h; Angle between the horizon and a star. Identify the lower half of the celestial sphere by a minus sign.

Azimuth A; Measure from north toward east along the horizon.

ψ, δ, t – A decimal number (degree, minute, second)

↓

h, A

$$h = \sin^{-1}[\sin\psi\sin\delta + \cos\psi\cos\delta\cos t]$$

$$a = \cos^{-1}\left[\frac{\sin\delta - \sin\psi\sin h}{\cos\psi\cos h}\right]$$

$$A = \begin{cases} 360 - a & ; \sin t \geqq 0 \\ a & ; \sin t < 0 \end{cases}$$

Example 1

Calculate h and A of the star whose declination is 12°14′54″ and hour angle 25°39′21″ at 41°21′34″ N Lat.

Example 2

Calcualte δ and t of a star whose altitude is 61° and azimuth 246° at 41°21′34″ N Lat.

Step	Data input operation	Read-out	Step	Data input operation	Read-out
	MODE 1	0.	7	(φ) 41.2134 EXE	D / h ? 41.35944444
1	⟨Ex.1⟩ PO	P ? 0.	8	(h) 61 EXE	t / A ? 61.
2	(φ) 41.2134 EXE	D / h ? 41.35944444	9	246 EXE	h / D= 25°27′46.16″
3	(g) 12.1454 EXE	t / A ? 12.24833333	10	EXE	A / t = 29°22′35.07″
4	(t) 25.3921 EXE	h / D= 53°15′37.82″	11		
5	EXE	A / t = 225°1′5.07″	12		
6	⟨Ex.2⟩ AC PO	P ? 0.	13		

Remarks

Program for

Astronomical observation

	Program	Remark	Step
	MODE 3 2ndF MAC MODE 2		
1	P0 MODE 4 ┘		1
2	"AL ┘CAPS P ┘α-S ? ┘ AL" ┘HLT ┘		6
3	GSB SHIFT P9 ┘ Min 01 ┘		8
4	"AL ┘D ┘α-S / ┘ CAPS h ┘α-S ? ┘ AL" ┘ HLT ┘ GSB SHIFT P9 ┘ Min 02 ┘		17
5	"AL ┘t ┘α-S / ┘ CAPS A ┘α-S ? ┘ AL" ┘ HLT ┘ GSB SHIFT P9 ┘ Min 03 ┘		26
6	MR 01 ┘ sin ┘ × ┘ MR 02 ┘ sin ┘ + ┘ MR 01 ┘ cos ┘ × ┘ MR 02 ┘ cos ┘		37
7	× ┘ MR 03 ┘ cos ┘ = ┘ SHIFT $\sin^{-1}$ ┘ Min 04 ┘ SHIFT $\overleftarrow{\circ\,'\,''}$ ┘		44
8	"AL ┘ CAPS h ┘α-S / ┘ CAPS D ┘ = ┘ AL" ┘ HLT ┘		51
9	(┘ MR 02 ┘ sin ┘ − ┘ MR 01 ┘ sin ┘ × ┘ MR 04 ┘ sin ┘) ┘ ÷ ┘		62
10	MR 01 ┘ cos ┘ ÷ ┘ MR 04 ┘ cos ┘ = ┘ SHIFT $\cos^{-1}$ ┘ Min 05 ┘		70
11	MR 03 ┘ sin ┘ SHIFT $x \geq 0$ ┘ GOTO 3 ┘ MR 05 ┘ GOTO 4 ┘		76
12	LBL 3 ┘3 ┘6 ┘0 ┘ − ┘ MR 05 ┘ = ┘		83
13	LBL 4 ┘ SHIFT $\overleftarrow{\circ\,'\,''}$ ┘ "AL ┘A ┘ α-S / ┘ CAPS t ┘ = ┘ AL" ┘		91
14			
15	SHIFT P9 Min 09 ┘ SHIFT INT ┘ + ┘ (┘ MR 09 ┘ SHIFT FRAC ┘ × ┘ 2 ┘ SHIFT 10^x ┘) ┘		10
16	Min 09 ┘ SHIFT INT ┘ ÷ ┘ 6 ┘ 0 ┘ + ┘ MR 09 ┘ SHIFT FRAC ┘ ÷ ┘ 3 ┘ 6 ┘		21
17	= ┘		22
18			
19		Total 115	
20			
21			
22			
23			
24			
25			
26			
27			
28			
29			
30			
31			
32			
33			
34			
35			
36			
37			

	Contents in memories
00	
01	ψ
02	δ
03	t
04	h
05	a
06	
07	
08	
09	For subroutine
F	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
1F	
20	
21	
22	
23	
24	
25	
26	
27	
28	
29	
2F	

Note

φ (Psi) is displayed as P.

δ (Delta) is displayed as D.

For (φ, h, A) → (δ, t), (δ, t) is determined by inputting h to δ and A to t.

Use the decimal-like representation for the input format of angle, i.e. 12.3456 for 12°34′56″.

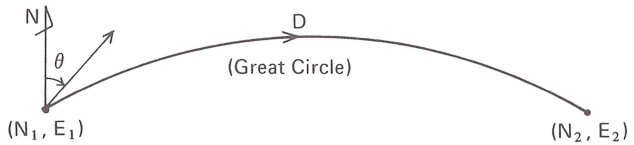
CASIO PROGRAM SHEET

Program for	No.	
Great circle navigation	Navigation-2	

Description

• Input the program written in the next page.

When the terrestrial latitudes and longitudes of two points are given, this program allows to calculate the shortest distance between the two points and the azimuth (from north toward east) at the start point.



D: Distance between two points (in nautical miles)
1 nautical mile = 1.852 km

θ_i: Azimuth at the start point (The azimuth will change with sailing.)

$$D = 60\cos^{-1}\{\sin N_1 \sin N_2 + \cos N_1 \cos N_2 \cos(E_2 - E_1)\}$$

$$\theta_i = \cos^{-1}\left\{\frac{\sin N_2 - \sin N_1 \cos\left(\frac{D}{60}\right)}{\sin\left(\frac{D}{60}\right)\cos N_1}\right\}$$

$$\theta = \begin{cases} \theta_i & ; \sin(E_2 - E_1) \geqq 0 \\ 360 - \theta_i & ; \sin(E_2 - E_1) < 0 \end{cases}$$

* North latitude and east longitude should be expressed by positive numbers, and south latitude and west longitude by negative numbers. However, Lat. 90°N (north pole) and Lat. 90°S (south pole) can not be input.

Example

(Lat. 33°53'30"S, Long. 18°23'10"E) ⟶ (Lat. 40°27'10"N, Long. 73°49'40"W)

Step	Data input operation	Read-out	Step	Data input operation	Read-out
	MODE 1	0.	7		
1	PO	N I ? 0.	8		
2	33.533 +/- EXE	E 1 ? -33.89166667	9		
3	18.231 EXE	N 2 ? 18.38611111	10		
4	40.271 EXE	E 2 ? 40.45277778	11		
5	73.494 +/- EXE	D= 6763.092554	12		
6	EXE	T= 304°28'46.4"	13		

Remarks

Program for

Great circle navigation

	Program	Remark	Step
	MODE 3 2ndF MAC MODE 2		
1	PO MODE 4		1
2	"AL CAPS N 1 α-S ? AL" HLT GSB SHIFT P9 Min 01		9
3	"AL E 1 α-S ? AL" HLT GSB SHIFT P9 Min 02		17
4	"AL N 2 α-S ? AL" HLT GSB SHIFT P9 Min 03		25
5	"AL E 2 α-S ? AL" HLT GSB SHIFT P9 Min 04		33
6	− MR 02 = Min 05		37
7	MR 01 sin × MR 03 sin + MR 01 cos × MR 03 cos		48
8	× MR 05 cos = SHIFT $\cos^{-1}$ Min 06 × 6 0 = Min 07		59
9	"AL D = AL" HLT		64
10	(MR 03 sin − MR 01 sin × MR 06 cos) ÷		75
11	MR 06 sin ÷ MR 01 cos = SHIFT $\cos^{-1}$ Min 08		83
12	MR 05 sin SHIFT $x \geq 0$ GOTO 1 3 6 0 −		91
13	LBL 1 MR 08 = SHIFT ⇐ "AL T = AL"		99
14			
15	SHIFT P9 Min 09 SHIFT INT + (MR 09 SHIFT FRAC × 2 SHIFT 10^x)		10
16	Min 09 SHIFT INT ÷ 6 0 + MR 09 SHIFT FRAC ÷ 3 6		21
17	=		22
18		Total 123	
19			
20			
21			
22			
23			
24			
25			
26			
27			
28			
29			
30			
31			
32			
33			
34			
35			
36			
37			

	Contents in memories
00	
01	N_1
02	E_1
03	N_2
04	E_2
05	$E_2 - E_1$
06	D/60
07	D
08	θ_i
09	For subroutine
F	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
1F	
20	
21	
22	
23	
24	
25	
26	
27	
28	
29	
2F	

Note

θ (Theta) is displayed as T.

- Accuracy deteriorates for D which is smaller than 1 nautical mile.
- Use the decimal-like representation for the input format of angle, i.e. 12.3456 for 12°34′56″.

CASIO PROGRAM SHEET

Program for	No.	
Secret number game	Game–1	

Description

• Input the program written in the next page.

The calculator holds a secret number whose value is anywhere between 0 and 50. You have to guess that number by using messages as crossreferences. As you enter a guess (input a number) the calculator gives you a clue as to the general area of the secret number.

Example

Let the secret number be 25.

1st message `0<0>50.` (The secret number is between 0 and 50.)

Lower limit, Upper limit

If you input 35

2nd message `0<0>35.` (The secret number is between 0 and 35.)

If you input 15

3rd message `15<0>35.` (The secret number is between 15 and 35.)

If you input 25

4th message `HIT`

Subsequenty

`3.` (The secret number is hit at the third trial.)

Step	Data input operation	Read-out	Step	Data input operation	Read-out
	MODE 1	0.	7		
1	PO	GAME START 0.	8		
2		0 < X > 50 10.	9		
3	35 EXE	0 < X > 35 35.	10		
4	15 EXE	15 < X > 35 35.	11		
5	25 EXE	HIT 25.	12		
6			13		

Remarks

Note that operation and results may vary from that shown above.

Program for

Secret number game

	Program	Remark	Step	Contents in memories
	MODE 3 2ndF MAC MODE 2			00
1	PO "AL CAPS G A M E α-s SPACE S T A R T AL"		12	01
2	SHIFT PAUSE 2ndF MAC AC 5 0 Min 08 Min 02 SHIFT RAN# SHIFT RAN#		21	02
3	× 2 SHIFT 10^x = SHIFT INT Min 06 − MR 08 = SHIFT $x \geq 0$		31	03
4	GOTO 1 GOTO 2		33	04
5	LBL 1 Min 06		35	05
6	LBL 2 Min F "AL α-s AR 01 α-s SPACE α-s < α-s SPACE X		43	06
7	α-s SPACE α-s > α-s SPACE α-s AR 02 AL" SHIFT PAUSE SHIFT x=F		50	07
8	GOTO 2		51	08
9	Min 08 1 M+ 09 MR 08 − MR 06 = SHIFT x=0 GOTO 4		60	09
10	SHIFT $x \geq 0$ GOTO 3 MR 08 Min 01 GOTO 2		65	F
11	LBL 3 MR 08 Min 02 GOTO 2		69	10
12	LBL 4 "AL H I T AL" MR 09		76	11
13				12
14		Total 77		13
15				14
16				15
17				16
18				17
19				18
20				19
21				1F
22				20
23				21
24				22
25				23
26				24
27				25
28				26
29				27
30				28
31				29
32				2F
33				
34				
35				
36				
37				

Note

CASIO PROGRAM SHEET

Program for	No.	
Gopher game	Game–2	

Description

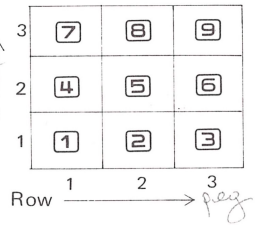
• Input the program written in the next page.

The idea is to rid an area of gophers (represented by numbered squares) by eliminating each one as it appears. The game tests your wits and reflexes. Numbers come onto the display to show the position of the hidden gopher and you must press the correct key within one second to score a hit. There are three similar games, explained below.

1. [P0] program

Message **A, B : C.**

- A → Number of gophers still to catch
- B → Horizontal position
- C → Vertical position



Example

Let's say a " 1, 2:9 " is displayed. This means the 1st column and 2nd row and there are 9 gophers to go. This means pressing the number 2 within a second will catch one gopher. If the input is not made fast enough, the chance is lost. When the series of squares has been completed the display shows your number of catches.

2. [P1] program

Message **A : C.**

- A → Number in question
- C → Number of remaining problems

In this game, divide the displayed number (A) by four and input the residual.
If "6:8" is displayed for example, depress key [2].

3. [P2] program

This is the same as the [P1] program but that the number (A) may have two digits.

Step	Data input operation	Read-out	Step	Data input operation	Read-out
	[MODE] [1]	0.	8		3.
1	[P0]	1,1 :10 0.	9	[P1]	7 :10 9.
2	[1]	1,1 :10 1.	10	[3]	7 :10 3.
3		2,3 :9 1.	11	⋮	⋮
4	[6]	2,3 :9 6.	12		
5	⋮	⋮	13		2 :1 1.
6		3,1 :1 8.	14	[2]	2 :1 2.
7	[7]	3,1 :1 7.	15		5.

Remarks

Steps 1, 3, 6, 9, and 12 display messages for approximately one second. In Steps 4, 7, 10, and 13, enter a value in response to display message within one second. Steps 8 and 14 display the number of correct answers in a single game (10 problems).

Program for

Gopher game

	Program	Remark	Step	Contents in memories
	MODE 3 2ndF MAC MODE 2			00
1	SHIFT P9 SHIFT RAN# | × | MR 08 | = | SHIFT INT |		5	01
2				02
3	SHIFT P7			03
4	LBL 1 | − | 4 | = | SHIFT $x \geq f$ | GOTO 1 |		6	04
5				05
6	SHIFT P6 2ndF MAC | 1 | 0 | Min 00 | Min 08 |		5	06
7				07
8	SHIFT P5			08
9	LBL 1 | GSB SHIFT P9 | Min 01 | ÷ | 4 | = | SHIFT FRAC | × | 4 | = | SHIFT INT |		11	09
10	Min 02 |		12	F
11	9 | = | "AL | α-S AR 01 | α-S SPACE | α-S : | α-S AR 00 |		19	10
12	AL" | SHIFT PAUSE | M− 02 | MR 02 | SHIFT $x=0$ | GOTO 3 |		25	11
13	LBL 2 | SHIFT DSZ | GOTO 1 | GOTO 4 |		29	12
14	LBL 3 | 1 | M+ 09 | GOTO 2 |		33	13
15	LBL 4 | MR 09 |		35	14
16				15
17	P0 GSB SHIFT P6 | 4 | Min F |		3	16
18	LBL 1 | GSB SHIFT P9 | SHIFT $x \geq f$ | GSB SHIFT P7 | SHIFT $x=0$ | GOTO 1 | Min 01 |		10	17
19	LBL 2 | GSB SHIFT P9 | SHIFT $x \geq f$ | GSB SHIFT P7 | SHIFT $x=0$ | GOTO 2 | Min 02 |		17	18
20	AC | "AL | α-S AR 01 | α-S , | α-S AR 02 | α-S SPACE | α-S : |		24	19
21	α-S AR 00 | AL" | SHIFT PAUSE | Min 07 |		28	1F
22	LBL 3 | (| MR 01 | − | 1 |) | × | 3 | + | MR 02 | − | MR 07 | = |		41	20
23	SHIFT $x=0$ | GOTO 6 |		43	21
24	LBL 5 | SHIFT DSZ | GOTO 1 | GOTO 7 |		47	22
25	LBL 6 | 1 | M+ 09 | GOTO 5 |		51	23
26	LBL 7 | "AL | AL" | MR 09 |		55	24
27				25
28	P1 GSB SHIFT P6 | GSB SHIFT P5 | "AL | AL" |		4	26
29				27
30	P2 GSB SHIFT P6 | 1 | 0 | 0 | Min 08 | GSB SHIFT P5 |		6	28
31				29
32		Total 123		2F
33				
34				
35				
36				
37				

Note

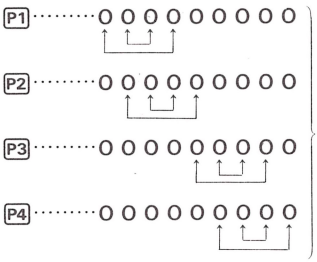
CASIO PROGRAM SHEET

Program for	No.	
Shuffle-number game	Game–3	

Description

• Input the program written in the next page.

The objective is to place the shuffled number in ascending order with the least number of steps. The digits from 1 to 9 will appear in shuffled form, you must rearrange them in proper order by depressing the right keys to make the changes as shown below. There are nine degrees of difficulty and a code should be selected first (1 = easiest, 9 = hardest) and [P0] pressed. The shuffled numbers will then be displayed and can be rearranged by use of the [P1] to [P4] keys which make the following movements:



Digits will be interchanged as shown at left depending on the key depressed.

Complete the game with the least number of key presses.

Variations: 1. Follow the reverse sequence if you can remember it.

2. See if you can input the initial number directly.

Step	Data input operation	Read-out	Step	Data input operation	Read-out
	[MODE] [1]	0.	10		To retry with 451287639.
1	(degree of difficulty) 2 [P0]	LEVEL 3 2.	11	(9th digit) 4 [Min] [0] [1]	4.
2		451236789.	12	(8th digit) 5 [Min] [0] [2]	5.
3	(reverse) [P2]	432156789.	13	⋮	⋮
4	(reverse) [P1]	123456789.	14	(1st digit) 9 [Min] [0] [9]	9.
5	(degree of difficulty) 3 [P0]	LEVEL 3 3.	15	[SHIFT] [P5]	451287639.
6		345129876.	16	(reverse) [P3]	451236789.
7	(reverse) [P4]	345126789.	17	(reverse) [P2]	432156789.
8	(reverse) [P1]	154326789.	18	(reverse) [P1]	123456789.
9	(reverse) [P2]	123456789.	19		

Remarks

Steps 1 and 5 are degree of difficulty.

Steps 4, 9, and 18 end the program.

Program for

Shuffle-number game

	Program	Remark	Step
	MODE 3 2ndF MAC MODE 2		
1	SHIFT P5 9 | Min 00 | AC |		3
2	LBL 1 | + | SHIFT IND | MR 00 | × | MR 00 | +/- | SHIFT 10^x | = | SHIFT DSZ |		13
3	GOTO 1 | × | 9 | SHIFT 10^x | = |		18
4			
5	SHIFT P6 MR 01 | X-M 04 | Min 01 | MR 02 | X-M03 | Min 02 |		6
6			
7	SHIFT P7 MR 02 | X-M05 | Min 02 | MR 03 | X-M04 | Min 03 |		6
8			
9	SHIFT P8 MR 05 | X-M08 | Min 05 | MR 06 | X-M07 | Min 06 |		6
10			
11	SHIFT P9 MR 06 | X-M09 | Min 06 | MR 07 | X-M08 | Min 07 |		6
12			
13	P1 GSB SHIFT P6 | GSB SHIFT P5 |		2
14			
15	P2 GSB SHIFT P7 | GSB SHIFT P5 |		2
16			
17	P3 GSB SHIFT P8 | GSB SHIFT P5 |		2
18			
19	P4 GSB SHIFT P9 | GSB SHIFT P5 |		2
20	P0 Min F | "AL | CAPS L | E | V | E | L | α-s SPACE | α-s # | AL" | AC |		11
21	9 | Min 00 |		13
22	LBL 1 | MR 00 | SHIFT IND | Min00 | SHIFT DSZ | GOTO 1 | MR F | Min 00 | 0 |		22
23	LBL 3 | Min F |		24
24	LBL 4 | SHIFT RAN# | SHIFT RAN# | × | 1 | 0 | = | SHIFT INT | SHIFT x=F | GOTO 4 |		34
25	X-M F | 6 | X-M F | SHIFT $x \geq$ F | GOTO 2 |		39
26	+ | 4 | = | SHIFT $x \geq$ F | GOTO 2 | + | 3 | = |		47
27	LBL 2 | X-M00 | SHIFT X-Y | SHIFT IND | GSB 0 | SHIFT X-Y | X-M00 | SHIFT DSZ |		55
28	GOTO 3 | GSB SHIFT P5 | Min F |		58
29			
30		Total 118	
31			
32			
33			
34			
35			
36			
37			

Note

	Contents in memories
00	
01	9th digit of target value
02	8th digit of target value
03	7th digit of target value
04	6th digit of target value
05	5th digit of target value
06	4th digit of target value
07	3rd digit of target value
08	2nd digit of target value
09	1st digit of target value
F	Target value
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
1F	
20	
21	
22	
23	
24	
25	
26	
27	
28	
29	
2F	
20	

CASIO PROGRAM SHEET

Program for	No.	
Hit-and-blow game	Game-4	

Description Guess a 4-digit number • Input the program written in the next page.

Operation:

1) Let the calculator hold a four-digit number by the following operation.
Key operation: [MODE], [1] (The calculator is now in the RUN mode), [P4] (A four-digit random number consisting of different digits is generated and held by the calculator.)

2) Guess the number the calculator holds by inputting a four-digit number.
Key operation: □, □, □, □, [P0] (□: numeric key).

3) The calculator judges whether you are right or not.

Example: Let us assume the calculator holds "1234".
If your guess is "5432" (key operation: [5], [4], [3], [2], [P0]), the calculator displays:

1° 2′ 1″ (1 hit and 2 blows)

- Means first trial
- Number of right digits but in wrong positions (called "blows", "4" and "2" in this case)
- Number of right digits in right positions (called "hits", "3" in this case)

Referring to the message displayed, you make a guess several times until the right number is reached.
When your guess "hits" the secret number (key operation: [1], [2], [3], [4], [P0]), the calculator displays:

4° 0′ n″ (You have succeeded at the n-th trial.)

Now the game ends.
To restart the game with a new secret number, depress [P4].

Step	Data input operation	Read-out	Step	Data input operation	Read-out
	[MODE] [1]	0.	7	1234 [P0]	? : ? : ? : ? 4° 0′ 6″
1	[P4]	? : ? : ? : ? 0.	8		
2	5432 [P0]	? : ? : ? : ? 1° 2′ 1″	9		
3	8901 [P0]	? : ? : ? : ? 0° 1′ 2″	10		
4	5231 [P0]	? : ? : ? : ? 2° 1′ 3″	11		
5	7241 [P0]	? : ? : ? : ? 1° 2′ 4″	12		
6	1236 [P0]	? : ? : ? : ? 3° 0′ 5″	13		

Remarks
Step 2 is (1 hit, 2 blows); Step 3 is (1 hit, 2 blows); Step 4 is (2 hits, 1 blow); Step 5 is (1 hit, 2 blows); Step 6 is (3 hits); Step 7 indicates (correct on 6th try).

Program for **Hit-and-blow game**

	Program	Remark	Step
	MODE 3 2ndF MAC MODE 2		
1	SHIFT P5 × 1 0 =		4
2	P6		
3	P4 2ndF MAC 1 Min 00		3
4	LBL 1 SHIFT RAN# SHIFT RAN# GSB SHIFT P5 SHIFT INT Min F SHIFT IND Min 00		11
5	MR 00 Min 05		13
6	LBL 2 1 M− 05 MR 05 SHIFT x=0 GOTO 3		19
7	SHIFT IND MR 05 SHIFT x=F GOTO 1 GOTO 2		24
8	LBL 3 4 Min F MR 00 SHIFT x=F GOTO 4 SHIFT ISZ GOTO 1		32
9	LBL 4 SHIFT IND MR 00 × (MR 00 − 1) SHIFT 10^x +		43
10	SHIFT DSZ GOTO 4 X→M08 AC "AL α-s ? α-s : α-s ?		51
11	α-s : α-s ? α-s : α-s ? AL"		56
12	P5		
13	P0 Min 07 3 6 0 0 SHIFT $1/x$ M+ 09 MR 07 ÷ 4		10
14	Min 07 SHIFT 10^x = Min 06 0 Min 05		16
15	LBL 1 4 Min 00 MR 06 GSB SHIFT P5 Min 06 SHIFT INT Min F		24
16	M− 06		25
17	LBL 2 SHIFT IND MR 00 SHIFT x=F GOTO 4 SHIFT DSZ GOTO 2		32
18	LBL 3 1 M− 07 MR 07 SHIFT x=0 GOTO 6 GOTO 1		39
19	LBL 4 MR 07 − MR 00 = SHIFT x=0 GOTO 5		46
20	6 0 SHIFT $1/x$ M+ 05 GOTO 3		51
21	LBL 5 1 M+ 05 GOTO 3		55
22	LBL 6 MR 09 M+ 05 MR 05 SHIFT "←"		60
23			
24		Total 123	
25			
26			
27			
28			
29			
30			
31			
32			
33			
34			
35			
36			
37			

Note

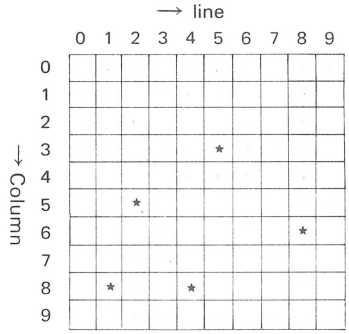
Contents in memories	
00	
01	
02	
03	
04	
05	
06	
07	
08	
09	
F	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
1F	
20	
21	
22	
23	
24	
25	
26	
27	
28	
29	
2F	

CASIO PROGRAM SHEET

Program for	No.	
Search-bug game	Game-5	

Description

• Input the program written in the next page.



Five bugs hide in 100 boxes arranged in a square as shown at left. You try to catch them with a net.
Place your net on a box by designating its column and row positions. Then the calculator displays a message. Referring to the message, guess where the bugs hide, the bug will move away to a neighboring box. It may flee to a far box if it stays at the edge of the square when the net is placed close.

Contents of message:

[P4] mwm ····· 5 bugs hide

Search Bugs ····· preparation completed

[P0]

Right → n:m ..... captured

Wrong → n:m ..... missed

Ri/Wr → n:m ..... captured on the line but missed on the column

Wr/Ri → n:m ..... captured on the column but missed on the line

Number of trials

Number of uncaptured bugs

Step	Data input operation	Read-out	Step	Data input operation	Read-out
	[MODE] [1]	0.	7		
1	[P4]	n w m 0.	8		
2		S e a r c h B u g s 5.	9		
3	(5th line/ 4th column) 5.4 [P0]	W r o n g → 5 : 1 0 . 1	10		
4	(6th line/ 4th column) 6.4 [P0]	R i / W r → 5 : 2 0.	11		
5	(7th line/ 3rd column) 7.3 [P0]	R i g n t → 4 : 3 0.	12		
6	⋮	⋮	13		

Remarks

Program for

Search-bug game

	Program	Remark	Step	Contents in memories
	MODE 3 2ndF MAC MODE 2			00
1	SHIFT P7 SHIFT RAN# | × |MR 1 F | = |SHIFT INT|		5	01
2	P9			02
3	SHIFT P8 MR 07 | − | 1 | = |SHIFT x=0|GOTO 1 |"AL|CAPS R|CAPS i|		9	03
4	α-s / |CAPS W|CAPS r|α-s →|α-s AR08|α-s : |α-s AR09|		16	04
5	AL"|GOTO 2|		18	05
6	LBL 1 |"AL|CAPS W|CAPS r|α-s / |CAPS R|CAPS i|α-s →|α-s AR08|		27	06
7	α-s : |α-s AR09|AL"|		30	07
8	LBL 2|		31	08
9	P7			09
10	P0 Min 06| 5 |Min 00| 1 |M+ 09|0|Min 07|		7	F
11	LBL 2 |MR 1 F |Min F |SHIFT IND|MR 00|SHIFT $x\geq$F|GOTO 8 |SHIFT INT| − |		16	10
12	MR 06|SHIFT INT| = |SHIFT ABS|Min F |MR 06|SHIFT FRAC| − |		24	11
13	SHIFT IND|MR 00|SHIFT FRAC| = |		28	12
14	SHIFT ABS|M+ F |0|SHIFT x=F|GOTO 3 | 1 |SHIFT x=F|GOTO 6 |		36	13
15	• | 1 |SHIFT x=F|GOTO 6 |		40	14
16	LBL 8 |SHIFT DSZ|GOTO 2|GOTO 4|		44	15
17	LBL 6 |MR F |Min 07|GSB SHIFT P7|÷| 2 | = |SHIFT FRAC|SHIFT x=0|		53	16
18	GOTO 7 | 1 |		55	17
19	LBL 7 |Min 06|GSB SHIFT P7|÷| 2 |SHIFT FRAC|SHIFT x=0| • | 1 |		65	18
20	SHIFT IND|GOTO 6|		67	19
21	LBL 0 |SHIFT IND|M+ 00|SHIFT IND|M+ 00|		72	1F
22	LBL 1 |SHIFT IND|M− 00|MR 1 F |Min F |SHIFT IND|MR 00|SHIFT $x\geq$F| 1 |		81	20
23	0 |SHIFT IND|M− 00|SHIFT IND|MR 00|SHIFT ABS|SHIFT IND|Min 00|		89	21
24	GSB SHIFT P8|GOTO 5|		91	22
25	LBL 3 |MR 1 F |SHIFT IND|M+ 00| 1 |M− 08|"AL|CAPS R|CAPS i|		100	23
26	g|h|t|α-s →|α-s AR08|α-s : |		106	24
27	α-s AR09|AL"|GOTO 5|		109	25
28	LBL 4 |"AL|CAPS W|CAPS r|o|n|g|α-s →|		117	26
29	α-s AR08|α-s : |α-s AR09|AL"|		121	27
30	LBL 5|		122	28
31	Continued to next page			29
32				2F
33				
34				
35				
36				
37				

Note

Program for **Search-bug game**

	Program	Remark	Step	Contents in memories
	P 8			00
1	P4 2ndF MAC 1 Min 00 1 0 Min 1 F		6	01
2	LBL 1 "AL m AL" MR 00 Min 06 GSB SHIFT P7 SHIFT IND		14	02
3	Min 00 GSB SHIFT P7 ÷ MR 1 F = "AL m		21	03
4	W AL" SHIFT IND M+ 00 SHIFT IND MR 00 Min F		28	04
5	"AL n W m AL"		33	05
6	LBL 2 1 M− 06 MR 06 SHIFT x=0 GOTO 3 SHIFT IND MR 06 SHIFT x=F		42	06
7	GOTO 1 GOTO 2		44	07
8	LBL 3 MR 00 Min F 5 SHIFT x=0 SHIFT x=F GOTO 4 SHIFT ISZ GOTO 1		52	08
9	LBL 4 5 Min 08 "AL CAPS S CAPS e a r c		61	09
10	h α-s SPACE CAPS B CAPS u g s AL"		68	F
11				10
12		Total 230		11
13				12
14				13
15				14
16				15
17				16
18				17
19				18
20				19
21				1F
22				20
23				21
24				22
25				23
26				24
27				25
28				26
29				27
30				28
31				29
32				2F
33				
34				
35				
36				
37				

Note

CASIO®

SA03012001A (英) Printed